

The Database of Cost References by Group—PDF#12

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SPACECRAFT, SATELLITES

ss1 – OGO Spacecraft

Cost -- \$17 million (for 2 additional units)

Discussion – TRW Space Technology Laboratories will build two additional orbiting geophysical observatory (OGO) satellites under a \$17 million contract now being negotiated with National Aeronautics and Space Administration. OGO 4 will be launched into a polar orbit and OGO 5 will be put into a highly elliptical orbit with an apogee of over 90,000 mi. Launches are scheduled for late 1965 and early 1966.

Source – Aviation Week, April 20, 1964, p 39.

Recorded – October 23, 1964.

ss2 – OGO Spacecraft

Cost – \$8.5 million each.

Discussion – NASA is negotiating with TRW Space Technology Laboratories to purchase two more Orbiting Geophysical Observatory (OGO) spacecraft at a cost of \$17 million. OGO D – the first of the two – will be launched in 1965, carrying some 20 scientific experiments into a 600-mi. polar orbit. OGO E, expected to be launched in 1966, will take about the same number of experiments into a highly elliptical orbit with an apogee of 90,000 miles.

Source – Missiles & Rockets, April 20, 1964, p 9.

Recorded – October 23, 1964.

ss3 – Lunar Orbiter Spacecraft

Cost -- \$16 million (?)

Discussion -- The Boeing Co. has been formally awarded a \$80 million contract to build five Lunar Orbiter spacecraft (M/R, Jan 6, p 13)

Kodak Eastman Co. will build the craft's cameras and Radio Corp. of America, its power and communications subsystems.

Source – Missiles & Rockets. May 18, 1964, p 10.

Recorded -- October 23, 1964.

ss4 – Orbiting Solar Observatory, OSO

Cost -- \$160,000/unit

Discussion -- \$800,000 – Ball Brothers Research Co., Boulder, Colorado, for construction of the last five of the eight planned Orbiting Solar Observatories.

Source – Missiles & Rocket, March 9, 1964.

Recorded – October 23, 1964.

ss5 – OSO Spacecraft

Cost -- \$160,000/unit

Discussion – Ball Bros. Research Corp. has received an \$800,000 National Aeronautics and space Administration contract to start construction of five more orbiting solar observatory satellites. The company has built three of the payloads.

Source – Aviation Week, March 9, 1964, p

Recorded – October 23, 1964.

ss6 – SECOR Satellite (Sequential Collation of Range)

Cost -- \$500,000/unit

Discussion – This Corp. of Engineers program is actually a relatively simple and lightweight (36 lbs) satellite – borne ranging device, to be used primarily for geodetic purposes. The system employs a series of three ground stations – each positioned in a well defined terrestrial location – to determine the exact special coordinates of the SECOR Satellite. Prime contractor for SECOR is the Cubic Corp. of San Diego, which turns out the satellites at a cost of roughly \$500,000 each.

Source – Missiles & Rockets, March 26, 1962, p 44

Recorded – October 23, 1964.

ss7 – Spacecraft R & D Program Costs and Weight Summary

Costs – Sample as follows

Discussion –

Program	Vehicle Weight (lbs)	R & D Cost (\$mil)	R & D Cost (\$/lb)
Advent	1350	85	63
Agna	1500	100	65
ASROC	1000	65	65
Centaur	2400	180	75
Courier	475	40	84
Delta	1300	38	29
Discoverer	2100	100	477
Dyna Soar	10,000	250	25
Genie	900	30	333

Other satellites include, Mariner, Mercury, Nimbus, OAO, OGO, OSC, Pioneer, Ranger, Relay, Samos, Surveyor, Syncon, Talos, Telstar, Tiros, Transit, Vela Hotel.

Source – TOR-669(6303)-6, Aerospace Corp, El Segundo, October 13, 1966.

Recorded – October 1966, updated October 29, 2009.

ss8 – NASA Budgeted Program Costs

Costs – as follows in millions of dollars

Discussion –

	S/C	Experiments	Ground Operations & Data Analysis	Total Costs
Ranger 1-5*	\$53.6**	\$8.9		\$62.5

Ranger 6-9*	51.7	26.6	8.7	87.0
Mariner R*	17.1	4.4	3.5	25.0
Mariner C*	59.5	12.3	12.4	84.2
Surveyor 1-7	198.0	19.2	20.5	237.7
Pioneer*	21.9	6.2	1.7	29.8
IMP*	6.0	2.0	0.3	8.3
OSO	2.5	2.5	2.1	7.1
OGO*	79.6	31.0	3.2	113.8
Relay*	15.2	0.4	25.4	41.0
Syncom*	13.8		16.8	30.6
Tiros	5.2	1.9	6.0	13.1

- Programs used to establish the coefficient
 - Includes some ground operations and data analysis costs
- Source – Table 3, NASA Budgeted Program Costs, Source: NASA Centers, Report No. C-4, “Progress on Spacecraft Cost Estimation Studies,” Astro Sciences Center of IIT Research Institute, Chicago, Illinois, for Lunar and Planetary Program Office, NASA, Contract No. NASA-65(06), October 1964.
Recorded – October 1964.

ss9 – Lunar Rover Vehicle Program

Cost – Total program = now in excess of \$30 million

Discussion – is overrunning its budget

Includes 4 flight vehicles and 7 test units, was expected to be \$19 million.

17 months from go-ahead to first delivery.

Source – Aviation Week, January 25, 1971, p 19.

Recorded – April 14, 1971.

ss10 – Space Shuttle Cost of Orbiting Payloads

Cost -- \$20 to \$50 per pound.

Discussion – NASA & AF studies have shown in the past five years that a fully reusable space shuttle with flexible payload capability might reduce the cost of orbiting payloads from a present \$1,000/lb to Earth orbit on a Saturn 5 to as low as \$20 - \$50/lb.

Source – Aviation Week, June 22, 1970, p 109.

Recorded – July 13, 1970.

ss11 – SATCOM – NATO Phase 2 Communications Satellite

Cost -- \$10 million for each satellite

Discussion – A total of \$50 million has been spent on the first 2 phases.

\$20 million for the ground terminals

Phase 1 consisted of flexibility tests with 2 Philco-Ford Mascot mobile ground terminals. The terminals, which have 16-ft. diam., antennas, are located at SHAPE Hq., near Casteau, Belgium, and AFSOUTH Hq., near Naples, Italy.

Phase 2 satellites are derivatives of the British Skynet military communications satellites developed by Philco-Ford Corp., Space and Re-entry Systems Division.

A satellite based on an existing US design was chosen for Phase 2 to keep development time to a minimum.

Source – Aviation Week, June 1, 1970, p 20.

Recorded July 16, 1970.

SS12 – Intelsat 4 Satellites for Communications Satellite Corp.

Cost – follow-on satellites would be \$7 million each.

Discussion – If a contract is let to Hughes Aircraft Company, before completion of the 8th Intelsat 4, Comsat said that the costs of the follow-on would be \$7 million.

This would compare with about \$9 million for the first Intelsat 4.

A new satellite, based on present technology, could be developed for launch by the McDonnell Douglas Thor Delta, instead of the General Dynamics Atlas-Centaur. This would reduce launch costs from \$17 million for the Atlas-Centaur to \$6 million for the Thor-Delta.

Comsat reported these cost to the FCC.

TRW Intelsat 3 program, \$93 million. This includes \$45 million for 8 satellites and \$48 million for launches. All of the satellites have been launched.

Hughes Intelsat 4 program, \$197 million. This includes \$61 million for 8 satellites and \$136 million for launches.

Source – Aviation Week, September 21, 1970, p 15.

Recorded – October 20, 1970.

SS13 – Hughes Domestic TV Satellite System

Cost -- \$47.2 million

Discussion – Hughes presented plan in an application to the FCC for a permit to construct an initial \$47.2 million domestic satellite system in collaboration with General Telephone and Electronics Corp.

The satellite pad weight would be 1,120 lbs and the orbital weight, about 550 lbs. The east and west coast transmit stations, costing about \$4.7 million each, would be connected by terrestrial microwave to operations centers near Los Angeles and New York that would perform programming activities.

The first 7 receive only stations, costing \$110,000 each, would be located at Elmira, NY, St. Petersburg, Fl, Eugene, Oregon, Denver, CO, Atlanta, GA, Los Angeles, CA, and NY, NY

Source – Aviation Week, January 4, 1971, p 16.

Recorded – February 10, 1971.

SS14 – NATO Communications Satellite

Cost -- \$100 million

Discussion -- It is reported that the US because of the difficulty of reaching from Belgium to southern Europe without installations in France, has suggested the stationing of a communication satellite in synchronous orbit.

Reference: Washington Post, September 29, 1966.

Source – Common Funding in NATO, RAND RM 5282, -PR, June 1967, p 40.

Recorded – October 5, 1970.

SS15 – Space Shuttle – Proposed Manned

Cost -- \$6 billion in research and development

Discussion – been established by NASA

If approved by the White house and Congress, that total will be spent over the next 5 years in industry and government studies leading to the first planned test flight of the 2nd state fully reusable shuttle system.

Total run out cost of the shuttle program including missions that would carry operational payloads, is about \$14 billion over the next two decades.

Source – Aviation Week, June 8, 1970, p 16.

Recorded – July 28, 1970.

SS16 – Aerosat – VHF/UHF Aeronautical Communications Satellite

Cost -- \$130 million for a North Atlantic system.

Discussion –

Source – Aviation Week, August 24, 1970, p 14.

Recorded – October 14, 1970.

SS17 – NASA Second Skylab

Cost -- \$1 billion to put a second Skylab into orbit because the manpower capability will have been depleted.

Source – Aviation Week, November 22, 1970, p 11.

Recorded – December 23, 1970.

SS18 – OAO – B-2, Proposed Backup Orbiting Astronomical Observatory

Cost – would have cost \$50-55 million

Discussion – to replace Grumman OAO-B, which failed to reach orbit last year when explosive bolts on its shroud failed to operate.

Source – Aviation Week, January 2w5, 1971, p 13.

Recorded – April 14, 1971.

SS19 – Manned Lunar Orbit Station

Cost – for 90-day mission is \$900 million.

Discussion –

Recorded – August 19, 1970.

SS20 – TRW 80-lb Satellite

Cost – Total program cost is estimated at \$5 million.

Discussion – TRW Space Vehicle Division is building 2 80 lb satellites.

Which will be ejected into lunar orbit by astronauts on Apollo missions 16 and 18. The satellites will be used for detection of solar wind particles and magnetic phenomena.

First delivery is scheduled for next May at Cape Kennedy

The satellites and launcher mechanism will weigh 95 lbs and will be part of the scientific instrument module.

Source – Aviation Week, June 8, 1970, p 65.

Recorded – July 28, 1970.

SS21 – Aerosat – Hybrid Aeronautical Satellite Proposed by Comsat Corp.

Cost – Rental Fee – as follows

Discussion – The proposed system would be launched by Comsat if users sign a 5 year rental agreement.

For a single ocean system, the total annual rental fee is estimated at \$14.5 million to be divided between the airlines and FAA, with perhaps NASA or foreign aviation agencies sharing in the cost. Comsat would have 2 spacecraft constructed, one to serve as a backup.

For a 2 satellite system, which would require fabrication of 3 spacecraft (including one for backup), the annual rental fee would be approximately \$19 million, Comsat estimates.

Source – Aviation Week, August 3, 1970, p 49.

Recorded – September 29, 1970.

SS22 – Weather Satellite – Prototype operational weather satellite.

Cost – Cost-plus-award-fee contract for about \$12.5 million.

Discussion – Philco-Ford Western Development Laboratory Division.

Includes design, construction and launch of 2 satellites that are expected to be turned over to the Environmental Science Services Administration (ESSA) after successful checkout in orbit.

SMS spacecraft will be 56 in. in diameter and 65 in. long.

A minimum of 120 w electrical power will be supplied by solar cells.

Source – Aviation Week, August 10, 1970, p 72.

Recorded – October 1, 1970.

SS23 – Lunar Landing

Cost -- \$21.35 billion

Discussion – Includes \$4.8 billion attributable to permanent facilities and flight hardware available for post-Apollo 11 missions, one of which already has been completed.

Apollo spacecraft = \$6.939 billion.

Saturn launch vehicles = Saturn 1, \$767 million, Saturn 1-B, \$1.127 billion, and Saturn 5, \$6.046 billion.

Engine development = \$854 million.

Operations support – Mission control system, \$229 million, launch operations, \$219 million, flight and crew operations, \$477 million, technical support, \$212 million.

Source – Aviation Week, March 2, 1970, p 52.

Recorded – April 1, 1970.

SS24 – Space Shuttle

Cost -- \$2.5 million each turn-around cost

Discussion – Space shuttle to provide biomedical documentation of ability to function over long periods in space, and to orbit more than 1 million lbs in one to

2 dozen launches at costs substantially lower than those involving the present Saturn 5 system.

Estimates of the costs of developing a space shuttle made by a Defense Department/NASA study were \$5.3 billion for research and development and the construction of 3 earth-to-orbit shuttle prototypes.

Another \$500 million for an orbit-to-orbit shuttle would be needed to move modules around in space.

At least another \$5 billion might be needed for long term development and operation of a permanent space station with capacity for 100 men.

If 5 vehicle systems each capable of making 100 trips in a 10 year period were to carry 25 million lbs of payload, the turn-around cost would be \$2.5 million each.

Once R&D are recovered from operational savings in comparison to use of expendable boosters, a reasonable payload to orbit cost would be below \$100/lb.

Transportation of unmanned vehicles to low orbit now typically costs \$1000/lb.

A synchronous mission costs \$10,000/lb.

Costs of orbiting a large space telescope of the 120 in diameter class would be as much as \$1 billion.

Source – Aviation Week, March 23, 1970, p 20.

Recorded – May 29, 1970.

SS25 – Special Space Shuttle

Cost – The potential cost of the shuttle, at a conservative estimate is \$10 billion.

Discussion – Simultaneously, NASA will issue requests for proposals on the shuttle's propulsion system.

In the proposed field, NASA has decided to eliminate the NA. Rockwell proposal for an Aerospike engine and to concentrate instead on the bell-nozzle work that will be proposed by such potential contractors as Pratt-Whitney Division of UA & CE.

Source – Aviation Week, January 19 1970, p 17

Recorded – March 11, 1970.

SS26 – Space Shuttle, NASA's Proposed Space Shuttle

Cost – projected runout cost estimated at more then \$10 billion.

Discussion –

Source – Aviation Week, April 13, 1970, p 18.

Recorded – June 17, 1970.

SS27 – NASA Space Shuttle

Cost – Ultimate runout cost projection cost \$14 billion.

Discussion –

Source – Aviation Week, May 4, 1970, p 15.

Recorded – June 25, 1970.

SS28 – Viking Mars, 1973 Viking Mars Lander Program

Cost – NASA estimates the runout costs at \$355 million.

Discussion – This is for Fiscal 1971-73 financing.

Fiscal 1969 allocation is \$8.1 million.
Fiscal 1970 budget includes \$40 million,
Fiscal 1971-73 runout for the 1973 Mariner-Mercury mission is \$118 million.
Initial financing is \$3 million in the Fiscal 1970 budget.
Source – Aviation Week, July 28, 1969, p 19.
Recorded – July 29, 1969.

ss35 – Viking Program

Cost -- \$750 million
Discussion – NASA now estimates the total cost of the Viking Program for a 1973 lander and orbiter mission to Mars.
A growth from \$400 million earlier this year (AWST, Oct 6, p 15).
Major items in the program are: a \$314 million contract with Martin Marietta Corp. for the lander, \$203 million for the Mariner-class orbiter being developed by Jet Propulsion Lab. And \$41.5 million for 2 Titan Centaur launch vehicles.
Source – Aviation Week, October 27, 1969, p 13.
Recorded – February 3, 1970.

ss29 – Satellite Network, of 4 satellites in synchronous orbit

Cost -- \$200-500 million for an operational system
Discussion – Within a decade, may take over the functions of tracking, command and communications in future spacecraft operations.
The cost within this range would depend upon how many of the existing surface station functions the space network assumed.
Source – Aviation Week, October 13, 1969, p 59.
Recorded – November 11, 1969.

ss30 – Projected Dioscures Commercial Satellite System.

Cost -- \$160 million per satellite.
Discussion – complete global coverage by the relay system in 2 steps
Launching of 5 satellites into geo-stationary orbit starting in 1972 for traffic control and telecommunications over the Atlantic and telecommunications over the Pacific.
Launching of 5 second-generation satellite relays starting in 1977 to provide complete global coverage for traffic control, navigation and telecommunications.
1st generation consist of 2 440 – lb satellite and earth stations in each zone.
System capacity – 6 tel. circuits, 2 telex circuits
2nd generation satellites would weigh about 1,500 lbs and provide a capacity 2 or 3 times greater.
1st generation can be put into operation for \$156 million, 8 launches and 6 ground stations.
Placing 2nd generation cost of \$360 million, 10 Centaur launches, \$160 million, and 2 additional ground stations + additions to 4 of the then existing stations, \$40 million.
Source – Aviation Week, November 24, 1969, p 31.
Recorded – January 30, 1970.

SS31 – Intelsat 3 Launch

Cost -- \$11.5 million

Discussion – Comsat's investment is 53% of the \$11.5 million.

Source – Aviation Week, January 19, 1970, p 25.

Recorded – February 2, 1970.

SS32 – Apollo II

Cost -- \$355 million

Discussion – Space expedition like Apollo II to the moon and back.

For \$355 million, the US could deploy at least 35 additional Minuteman missiles on earth and the Soviet Union could deploy at least 10 of its big 559's.

Source – Weekly News Summary, Washington Star, July 25, 1969, p 9, July 21, 1969.

Recorded – August 5, 1969.

SS33 – Apollo

Cost – approximately \$15 million.

Discussion – North American refurbished Apollo command module

About ½ the cost of a new command module.

Source – Aviation Week, November 3, 1969, p 13.

Recorded – February 2, 1970.

SS34 – Reusable Logistics Supply System for Space Station

Cost – as follows

Discussion – Von Braun said ... could cut the cost of placing a pound of payload in orbit down from the current \$500/lb to \$50/lb for the first and second generation space stations, and conceivably to \$30/lb with enough traffic.

Source – Aviation Week, November 10, 1969, p 61.

Recorded – February 3, 1970.

SS36 – Small Astronomy Satellite

Cost – as follows

Discussion – NASA plans to launch a US Small Astro. Sat. from Italy's San Marco equatorial pad in the Indian Ocean in September.

Ling-Temco-Vought Scout vehicles costing about \$1.5 million per launch will be used.

NASA estimates a substantial savings since Cape Kenney launches would require McDonnell Douglas Delta vehicles costing about \$6 million per launch.

Source – Aviation Week, January 26, 1970, p 13.

Recorded – March 11, 1970.

SS37 – Telemail Service – Domestic Communications Satellite

Cost -- \$321 million

Discussion – To establish a nationwide record-video service

GE said the required investment up to 1980 would be \$321 million.

- This would include: \$95.2 million for research and development,
\$55 million for satellites and boosters.
\$159 million for ground stations
\$10.6 million for a routing center and administration building
\$2 million for miscellaneous
Cost for Telex transmission of a 600-word message from NY to LA is now \$6, the
day telephone rate is \$1.75 and the night rate is \$.75
Source – Aviation Week, April 7, 1967, p 25.
Recorded – June 6, 1969.
- ss38 – MOL, Air Force Manned Orbiting Laboratory
Cost – one launch = \$20 million
Discussion – Reduction of the earlier seven-launch plan by one launch resulted in
a \$20 million saving.
Source – Aviation Week, April 21, 1969, p 17.
Recorded – June 19, 1969.
- ss39 – Satellite Air Traffic Control System
Cost – about \$32 million per year for satellite construction and launch.
Discussion – according to estimates of the Transportation Department and adhoc
Air Traffic Control Advisory Committee.
Each satellite would cost about \$20 million and its launch also would cost about
\$20 million. Average life of the satellites would be five years each.
3 satellites would be required to cover continental US, plus a 4th in orbit ready to
take over. This averages to 4 launches every 5 years, or an average cost of \$32
million per year. Ground station operating costs would be \$1-2 million per year.
Source – Aviation Week, March 31, 1969, p 28.
June 5, 1969.
- ss40 – Earth Orbit Station – 100 man earth orbit station
Cost – over a period of 10 years, estimated in excess of \$10 billion.
Discussion – Post-Apollo manned space flight program
With a multiplicity of capabilities varying from development of earth resources to
astronomy.
Schedule under consideration contemplates a launch of the first module of the
large space station with perhaps as many as 12 men by 1975,
Source – Aviation Week, February 24, 1969, p 16.
Recorded – June 5, 1969.
- ss41 – NASA Mariner Spacecraft
Cost – Projected runout cost of \$87 million for a single Mariner class spacecraft.
Discussion – carrying imaging devices to scan both planets (Venus and Mercury)
Source – Aviation Week, January 20, 1969, p 27.
Recorded – April 17, 1969.
- ss42 – Intelsat 4 Program

- Cost – The \$72 million contract finally awarded to Hughes Aircraft Company
Discussion – for 4 Intelsat 4s includes \$20 million in subcontracts to firms in 8 European countries, Japan and Canada.
Cost to Intelsat for the 4 satellites will be \$9 million or \$4 million more than it would be if Hughes performed the job itself.
Source – Aviation Week, January 27, 1969, p 23.
- SS43 – CETS, Television Relay Satellite Program
Cost -- \$103 million
Discussion –
Source – Aviation Week, November 25, 1968, p 20.
Recorded – January 7, 1969.
- SS44 – Nuclear Engines and Reusable Spacecraft
Cost – Payload costs are projected at \$5/lb.
Discussion –
Source – Aviation Week, October 14, 1968, p 15.
Recorded – December 19, 1968.
- SS45 – IRLS – Interrogation, Recording, and Location System
Cost – about \$15,000
Discussion – Nimbus B will be equipped with an IRLS capability for a balloon experiment over the US.
In connection with global weather forecasting.
Source – Aviation Week, February 12, 1968, p 24.
Recorded – July 22, 1968.
- SS46 – Nimbus B-2
Cost – about \$20 million
NASA officials plan to use space hardware and backup components to assemble Nimbus B-2, at a cost of \$20 million.
The MacDonnell Douglas Thor launch vehicle and Lockheed Agena D upper stage will cost another \$7 million.
The original Nimbus B mission cost \$61.9 million.
Source – Aviation Week, July 8, 1968, p 19.
Source – July 23, 1965.
- SS47 – OAO-2, Orbiting Astronomical Observatory
Cost – OAO-2 represents a \$75 million increase in program cost.
Discussion – to be launched October 30 from Cape Kennedy.
Before the failure of OAO-1, NASA had planned a five satellite series at a cost of about \$317 million. Since the program was sharply modified, NASA now plans only four spacecraft at an estimated runout cost of about \$390 million.
Neither cost figure includes the funding necessary for scientists and engineers to operate the spacecraft in orbit during a projected lifetime of six months to one year.

OAO-2 is 10 ft high, 21 ft wide with solar panels extended weighs 4,400 lbs, toward which the 2 major sets of experiments contribute about 1,000 lbs.

Source – Aviation Week, October 21, 1968, p 58.

Recorded – December 31, 1968.

SS48 – Austere Government Service – Communications Satellite

Cost – as follows

Discussion –

Cost Per Launch Attempt for Austere Service

Satellite Altitude, n.m.	10,000	10,000
Satellite Power Output, w	2	2
Number of Satellites/Launch	2	3
Cost per Launch Attempt \$ million		
Booster, Satellites, & Modifications	5.58	5.78
Launching Cost	2.32`	2.32
Total Cost/Launch Attempt	7.90	8.10

Source – Design & Use of an Early Communication Satellite System, RAND RM 3514 – NASA, July 1963.

Recorded – January 13, 1966.

SS49 – Heos, Highly Eccentric Orbit Satellite

Cost -- \$6.5 million satellite development

Discussion – Group headed by Junkers Flugzug und Motorenwerke AG and Lockheed Missiles and Space Company, has been selected by European space Research Organization (ESRO) to develop Heos.

Scheduled to launch by NASA from Cape Kennedy during second half of 1969, during a period of intense solar activity.

Launch vehicle is expected to be an improved Douglas Thor Delta. 220 lb payload.

Apogee of at least 125,000 mi, including of 33 degrees.

Source – Aviation Week, December 13, 1965, p 36.

Recorded – January 19, 1966.

SS50 – AOSO, Advanced Orbiting Solar Observatory

Cost -- \$142 million program

Discussion – The 1,250 lb AOSO was considered the critical data-gatherer of solar flare information that would be used in scheduling manned space flight programs. About \$39 million had been allocated to the \$142 million program, and NASA wanted to spend \$50 million on it next year.

Source – Aviation Week, December 20, 1965, p 15.

Recorded – January 20, 1966.

ss51 – Ranger

Cost -- \$12 million

Discussion – more than 1,500 firms contributed to the JPL designed Ranger, at a total cost of \$12 million.

Source – Electronic News, clipping, date unknown, probably 63-64.

Recorded – February 14, 1966.

ss52 – Tetrahedral, STL Satellite

Cost -- \$20,000

Discussion – Weight = 1 lb.

Source – Aviation Week, April 27, 1963.

Recorded – February 14, 1966.

ss53 – Pioneer Spacecraft

Cost -- \$15 million

Discussion – for 4 spacecraft, weight 100 lbs each.

Source – Aviation Week, June 17, 1963.

Recorded – February 14, 1966.

ss54 –Early Bird

Cost -- \$3.5 million, exclusive of launch expenses.

Discussion – The great proportion of this was for electronics.

COMSAT Corp. has a contract with ITT Fed. Labs. to furnish communications and control equipment for 2 earth stations at a cost of \$1,780,000 or \$890,000 each.

It has another contract with the Electronics Systems Div., of Sylvania Electric Products, Inc., for 2 antenna systems for \$4,650,000 or \$2,325,000 each.

This brings the cost of electronic equipment for an earth station to \$3,215,000. In addition, multiplexing and other equipment is needed which might add another \$500,000 to the cost. Total cost of an earth station, including buildings = \$6 M.

Source – Electronic News, Monday, February 14, 1966, p 9.

Recorded – February 22, 1966.

ss55 – Apollo Applications

Cost -- \$6 billion.

Discussion – Total estimated cost is at least \$6 billion, with well over one billion dollars being committed to funding of experimental payloads.

Source – Missiles & Rockets, November 29, 1965, p 43.\

Recorded – February 15, 1966.

ss56 – Communications Satellite

Cost – Annual costs per voice channel as follows:

Discussion – For a 2 year MTTF and a probability of launch success of 0.75, the annual cost per channel for the low-altitude system is \$24,000, as compared with

\$8,500 (on the assumption of full utilization) only slightly less than the \$27,000 cost per voice channel of a 3,000 mile cable link.

For the 24 hour system, with a 1 year MTTF and a 0.75 probability of launch success, the cost per voice channel is about \$27,000.

Original source: Meckling "Economic Potential of Communication Satellites, Science, June 16, 1961, vol 133. no., 3468.

Source – "Communications Satellite, Economics and Initial Development," Staff Report, Communication on Aero. & Space Science, US Senate, 87th Congress, 2nd Session, February 25, 1962, p 34.

Recorded – February 21, 1966.

ss57 – Convert Prototype OGO into a Flight Spacecraft

Cost -- \$9 million

Discussion – TRW Systems has been awarded an estimated \$9 million to convert the prototype Orbiting Geophysical Observatory (OGO) into a flight spacecraft. The converted prototype will be called OGO F, and will be the 6th launch in the series.

Source – Missiles & Rockets, January 31, 1966, p 9.

Recorded – February 14, 1966.

ss58 – Global Communications Satellite

Cost – Channel cost per year of \$600.

Discussion – compared with Early Bird's \$16,000.

Hughes projects.

Source – Missiles & Rockets, January 31, 1966, p 35.

Recorded – February 14, 1966.

ss59 – NASCOM/Interim Comsat

Cost -- \$11.7 million for 4 flight systems within 8 months = \$2.9 each.

Discussion – The only firm to respond to COMSAT's RFP was Hughes Aircraft. They were awarded contract.

Hughes 303A vehicle (excluding antennas and apogee kick (motor) will about twice the size (56 in. in diameter by 26 in high) and provide 3 times the power (18 watts) of Early Bird.

For NASCOM the system will provide 6 alternate voice for data circuits and 2 teleprinter circuits.

Source – Missiles & Rockets, January 31, 1966, p 50.

Recorded – February 14, 1966.

ss60 – ADSCP, Advanced Defense Satellite Communications

Cost -- \$10 to \$20 million for developing satellite.

Discussion – Current planning is based on a 1969 launching.

ADSCP will support the National Military Command System.

Source – Missiles & Rockets, January 31, 1966. p 64.

Recorded – February 15, 1966.

SS61 – Early Bird, Advanced Version of Early Bird for Apollo Program

Cost -- \$11.7 million for purchase of 4 synchronous satellites.

Discussion – US COMSAT Corp., which acts as manager for Intelsat, was authorized to sign an \$11.7 million contract with Hughes Aircraft Co., for purchase of four synchronous satellites for the system. One would be positioned over the Pacific between Hawaii and Midway Island. Another would be placed over the Atlantic near the West Coast of Africa to supplement Early Bird, which is in service over the east coast of Brazil. The other two satellites would be for backup.

Weight = 150 lbs compared with Early Bird's of 85 lbs.

Source – Aviation Week, November 8, 1965, p 24,

Recorded – December 20, 1965.

SS62 – Voyager Spacecraft

Cost – Program is now expected to go well over \$2 million.

Discussion – Major changes –

Saturn 1B Centaur launch vehicle development program cancelled.

Planned flight test of Voyager in 1969 will be cancelled.

Saturn V will be used as booster.

Increase in launch vehicle 10,000 lbs to 40,000-50,000 lbs.

Source – Missiles & Rockets, October 4, 1965, p 14.

December 20, 1965.

SS63 – Early Bird

Cost -- \$3 million

Discussion – The basic price for Early was \$3 million.

Source – Aviation Week, November 22, 1965, p 28.

Recorded – December 20, 1965.

SS64 – OSO Development Plans

Cost – as follows

Discussion –

	FY-65	FY-66FY-71	
				Total All Yrs
Spacecraft & Support	\$5,600,000	\$6,100,000		\$39,900,000
Experiments	4,300,000	5,300,000		32,400,000
Launch Vehicles	400,000	1,400,000		20,400,000
Total	\$10,300,000	\$12,800,000		\$92,700,000

Launch OSO-1 – FY-62

Launch OSO-C – FY-65

Launch OSO-C – FY-68

Accident OSO-B – FY-64

Launch OSO-D – FY-66

Launch OSO-G – FY-69

Launch OSO-II – FY-65

Launch OSO-E – FY-67

Launch OSO-H – FY-70

Source – Statement of Homer E. Newell, NASA, before Subc of Space and Science, House of Representatives, Solar Observatories, Program Objectives, 1965.

Recorded – December 22, 1965.

SS65 – ATS, Applications Technology Satellites

Cost -- \$100 million for ATS program

Discussion currently is programmed for 5 flights, with 3 basic missions.

Source – Missiles & Rockets, November 29, 1965, p 91.

SS66 – Voyager Program

Cost -- \$1.3 billion through the 1973 missions

Discussion –

Source – Missiles & Rockets, November 29, 1965, p 62.

Recorded – December 27, 1965.

SS67 – Hughes Advanced Synchronous Satellite

Cost -- \$10 million

Discussion – Cost to TV network to own and operate such a satellite, including launch costs and orbit support.

This cost could be amortized over the 5 year life of the satellite.

Development of a 1,550 lb highly advanced synchronous satellite system has been forecast by Dr. Harold A. Rosen of Hughe's Space Systems Division.

Suggesting essentially a system providing direct space to home video broadcast reception, Rosen estimated that stamped aluminum dishes could be made available for under \$40 each., home TV set conversion for less that \$100.

A 7 ft. diameter x 6 ft high satellite would be required, he said, capable of relaying perfect color or black and white TV programs anywhere except to the outer polar regions of the earth.

The earth station transmitting to the satellite would cost less than \$1 million, said Rosen.

Source – Missiles & Rockets, November 29, 1965, p 162.

Recorded – December 27, 1965.

SS68 – Comet Flyby Satellite

Cost -- \$15 – 20 million.

Discussion – using Mariner 4 backup spacecraft and a GD/Lockheed Atlas-Agena launch vehicle.

According to R. C. Jensen of Philco Western Development Labs.

Ideally, Jensen said, it would be preferable to use a new spacecraft for a commentary flyby – pushing total mission costs to about \$50 million, and two such probes have been designed by Western Development Labs.

One would use solar cells and the other would have a radioisotope power source.

Source – Aviation Week, November 29, 1965, p 46.

Recorded – December 28, 1965.

- ss69 – GHOST, Global Weather Experiment Using a Meteorological Satellite
 Cost -- \$50 million total program
 Discussion – and a network of sensors on constant altitude balloons, remote land stations and ocean buoys could be deployed in 4 years at a cost of about \$50 million, according to a report published recently by the panel on International Meteorological Cooperation.
 GHOST – global horizontal sounding technique – the concept would be aimed at extending atmospheric information.
 Source – Aviation Week, January 3, 1966, p 55.
 Recorded – January 25, 1966.
- ss70 – Japanese Satellite Launch
 Cost -- \$1,400,000
 Discussion – Japan’s plan to orbit its first satellite by early 1968 is progressing on schedule.
 The 56 in. diameter solid motor to be used as the booster for the launch vehicle, MU-4, has been successfully test fired.
 The satellite is scheduled for launch during FY-67 from Kagoshima Space Center in Kyushu by the University of Tokyo’s Institute of Space and Aeronautical Science.
 All the rocket and satellite components are being supplied by Japanese firms.
 Cost for the 1968 satellite launch is estimated at about \$1,400,000.
 MU-4, 72 ft long and 56 in diameter at base, 400,000 lb thrust.
 Payload capability 220 lbs into a 300 mile orbit.
 Source – Missiles & Rocket, December 20, 1965, p 29.
 Recorded – January 26, 1966.
- ss71 – MOL, Manned Orbiting Laboratory Flight Test Program
 Cost -- \$1 billion
 Discussion – 18 months period
 6 manned orbiting laboratory launches.
 Source – Aviation Week, December 23, 1963, p 26.
 Recorded – October 1, 1964.
- ss72 – Random COMSAT
 Cost -- \$100-120 million for establishing system
 Discussion – 24 satellites
 99.5% in service time over the North Atlantic
 3 satellites launched simultaneously
 Cost per launch \$10-12 million
 8 successful launches needed to establish system
 If 8 of 10 attempted launches succeed, the expected cost of establishing the orbiting subsystem is \$100-120 million.
 Expected annual cost of replacing satellites is the sum divided by the mean time to failure of the satellites, which would be \$35.40 million for a 3 year life, \$20-25 million for 5 year life.

Source – “Communication Satellite Systems,” *Astronautics & Aerospace Engineering*, September 1963, p 30.
Recorded – February 3, 1964.

SS73 – Stationary COMSAT

Cost -- \$120 million

Discussion – cost of launching a stationary satellite with enough capacity to be of commercial interest would probably be about \$15 million.

4 satellites for an early system, if accept occasional long system failure.

If chance of injecting a stationary satellite successfully is 50%, the expected cost of launching the satellites = \$120 million.

Source – “Communications Satellite Systems,” *Astronautics & Aerospace Engineering*, September 1963, p 30.

Recorded – February 3, 1964.

SS74 – Manned Orbital laboratory

Cost -- \$390 million for development, and construction of 2 units.

Discussion – 6 man

2 month stay per crew

Typical orbital system which consists of 2 six man orbital labs in orbit with different inclinations, and a few instrumented satellites in various altitudes, is considered a minimum requirement for the time period of 1965 to 1970.

The annual support of one lab is about \$120 million at a cost of \$5 million per flight of a vehicle of the Atlas Centaur type.

Source – *Aero/Space Engineering*, May 1960, “Design Criteria and the Application to Economical Manned Satellites,” p 25.

Recorded – February 4, 1964.

SS75 – Manned Space Station – Program Cost

Cost -- \$900.8 million – 5 year program

Discussion – Phase I (Entry Vehicle) = \$389.2 million

Phase II (STELLAB) = 219.9 million

Phase III (Entry Vehicle, STELLAB) = 291.7 million

Total Program Cost = 900.8 million

300 mile orbit

3 man 14 day station

Entry vehicle – 583 lbs of expendables (food, oxygen, etc.) for provision of space station.

Test station = 10,090 lbs with entry vehicle = 5,750 lbs and the STELLAB (including 673 lbs of tests and associated equipment weighing 4,340 lbs.

Source – *Aero/Apace Engineering*, May 1960, “Program Costs for a Manned Space Station,” p 82.

Recorded – February 4, 1964.

SS76 – Entry Laboratory Vehicle

Cost – as follows in millions of dollars – R&D

Discussion --

Nonrecurring --	Recurring	Total
Entry Vehicle --	12.4	12.4
Structure --	(6.0)	(6.0)
Equipment --	(6.4)	(6.4)
Space Lab. --	36.0	36.0
Structure --	(3.2)	(3.2)
Equipment --	(32.8)	(32.8)
Boosters -- 103.1	49.2	152.3
Total -- 103.1	97.6	200.7
Ground Sup. Com -- 59.6	--	59.6
Flight Test Ops -- 16.6	--	16.6
Sup Progr. 9.7	--	9.7
Totals -- 189.0	97.6	206.6
Syst. Mgt. --	--	5.1
Grnd Total --		291.7

Source -- Aero/Space Eng., May 60, "Program Costs for a Manned Space Station," p 86.

Recorded -- February 4, 1964.

SS76 -- Entry Vehicle Program Costs

Cost -- as follows

Discussion -- Millions of dollars

	Non-Recurring	Recurring	Total
Airborne Systems			
Entry Vehicle	89.2	40.3	129.5
Structure	(42.0)	(19.5)	(61.5)
Equipment	(47.2)	(20.8)	68.0)
Totals	141.6	87.5	229.1
Ground Sup. Compl	99.5	--	99.5
(GSE,range,mods,)			
Flight Test Ops.	38.7	--	38.7
Support Progr.	15.0	--	15.0
TOTALS	294.8	87.5	382.3

System Mgt = 6.9 TOT = 389.2

Source -- Aero/Space Eng., May 1960, "Program costs for a Manned Space Station," p 83.

Recorded -- February 4, 1964.

SS77 -- Space Laboratories -- 5 yr program

Cost -- as follows

Discussion -- Millions of dollars

	Non-Recurring	Recurring	Total
Structure	37.4	4.0	31.4

Equipment	65.5	41.0	106.5
Boosters	6.9	9.6	16.5
Total	109.8	54.6	164.4
Ground Sup. Compl	36.7	--	35.7
Flight Test Op.	7.2	--	7.2
Support Prog.	7.7	--	7.7
TOTAL	161.4	54.6	616.0

System Mgt. = 3.9, TOTAL = 219.9

Source – Aero/Space Eng., May 64, “Program Costs for a manned Space Station,” p 83.

Recorded – February 4, 1964.

ss78 – Multimanned Space Station

Cost -- \$1,159.4 million R & D.

Discussion – Space Station & Subsystems = \$334.2

Boost vehicles = 418.6

Astrotugs = 36.2

Astrocommuters = 135.0

Dress rehearsals = 35.4

Launch base = 200.0

Total = 1,159.4

Main body of the initial station on orbit, 94 in wide – 108 in long

Modules: spheres – 18 in. diam; cylinders – 10 in diam – 30 in long

Assembly completed at 318 st. mil. on orbit 50 degrees to equator

Orbital life time would be about 1,450 days.

Source – Aero/Space Eng., May 1960, “A Modular Concept for a Multimanned Space Station,” p 90.

Recorded – February 4, 1964.

ss79 – Passive Satellite Subsystems

Cost – \$8.00 million per launch

Discussion – 1. 5 passive satellites = 0.50 millions of dollars

2. Booster procurement = 3.36

3. Booster adaption & syst. engr. = 1.32

4. Launch costs = 2.32

Total = 8.00

Source – RAND R-415, NASA, A Study of Passive Communication Satellites, February 1963, p 197.

Recorded – February 4, 1964.

ss80 – Passive Satellite

Cost -- \$64 million for emplacement

Discussion – assumes 0.75 probe of one booster successfully orbiting 5 satellites, and a system requirement of 30 satellites in orbit.

Naturally, if an indefinite satellite lifetime is assumed, 15 yr flight hardware costs still amount to only \$64 million.

Satellite Life-yrs	Total 15 yr Discounted Costs (millions)
1	591
2	317
3	212
4	137
7.5	100
15	64

Discounted costs are estimated on the assumption of an 8 % rate per year, with replacement occurring at evenly spaced intervals over 15 yrs.

Initial placement cost $NC(L)/N(1)P(L)$

N = no of satellites in orbit

N(1) = no. of satellites/launch

P(L) = probe of successful placement

C(L) = cost per launch

Source – RAND R-415-NASA, A Study of Passive Communications Satellites, February 1963, p 197.

Recorded – February 4, 1964.

SS81 – Active Satellite Subsystems

Cost -- \$9.00 million per launch

Discussion – 1. 5 active satellites	1.50
2. Booster proc	3.36
3. Boosteradaptation & syst engineering	1.82
4. Launch Costs	2.32
Total	9.00

Source – RAND R-415-NASA, A Study of Passive Communication Satellites, February 1963, p 197.

Recorded – February 4, 1964.

SS82 – Active Satellite

Cost -- \$72 million emplacement

Discussion – Sat. Life Yrs.	Total 15 yr Discounted Cost (millions)
1	667
2	358
3	239
4	154
5	154
7.5	114
15	72

Source RAND R-415-NASA, A Study of Passive Communication Satellites, February 1963, p 198.

Recorded – February 4, 1964.

SS83 – Orbiting Geophysical Observatory

Cost -- \$17 million

Discussion – TRW STL will build 2 additional OGO's under a 17 million contract

Now being negotiated with NASA.
OGO-4 will be launched into polar orbit.
OGO-5 will be put into a highly elliptical orbit with an apogee of over 90,000 mi.
Launches are scheduled for late 1965, early 1966.
Source – Aviation Week, April 20, 1964, p 39.
Recorded – May 7, 1964.

ss84 – Lunar Lander Research Vehicle

Cost -- \$2,300,000
Discussion – for two
Built by Bell Aerosystems Company, Buffalo
Free flight LLRV and astronaut trainer
Completely non-aerodynamic, flying a non-ballistic path on thrust alone.
Control system is fly-by-wire (electronic) only, with no manned backup- or
override.
Turbofan engine provides basic lift – GE CF700.
Pilot sits in a cockpit forward of main frame.
Source – Aviation Week, April 20, 1964, p 75.
Recorded – May 7, 1964.

ss85 – Early Bird Synchronous Satellite

Cost -- \$7.5 million
Discussion – Communications Satellite signed contract with Hughes Aircraft Co.
for 2 such satellites and part of a backup, subject to FCC approval.
Source – Aviation Week, April 20, 1964, p 25.
Recorded – May 7, 1964.

ss109 – Early Bird Satellite

Cost -- \$7.5 for two complete satellites and \$335,000 for parts of a third, plus
incentive provisions.
Discussion – FCC is expected to grant COMSAT CORP. to move forward with
assembly of a 3rd Hughes Aircraft Early Bird.
COMSAT estimated the assembly cost for the 3rd satellite at \$1.3 million.
Service in the Pacific.
Source – Aviation Week, July 5, 1965, p 20.

ss86 – MIDAS

Cost -- \$2-3 million implement MIDAS and \$100 million annual maintenance.
Discussion – 1969 earliest operational date.
Source – Aviation Week, February 3, 1964, p 33.
Recorded May 14, 1964.

ss87 – Advanced Technological Satellite

Cost -- \$126.5 million
Discussion – test spacecraft components, materials, systems, and techniques.
NASA

Source – Aviation Week, February 17, 1964, p 26.
Recorded – May 15, 1964.

ss88 – Nimbus Operational System

Cost -- \$50 – 60 million a year.

Discussion – The Weather Bureau also specified a system that could be maintained including 2 spacecraft in orbit, for between \$20 million and \$30 million a year.

A system employing 2 Nimbus spacecraft would have cost between \$50 million and \$60 million.

Source – Aviation Week, October 7, 1963, “Weather Bureau Rejects Nimbus for Operational Satellite Program,” p 31.

Recorded – January 29, 1964.

ss89 – Orbiting Astronomical Observatory (OAO)

Cost -- \$20 million if only OAO-C is acquired and in excess of \$50 million, if all three are purchased.

Discussion – 10 ft long cylinder weighing about 3,300 lbs.

About 1,000 lbs devoted to 2 experiment packages.

The Wisconsin experiment is a cluster of 4-8 in cylinder stellar photometer telescopes and two rectangular scanning spectrometers surrounding a 16 – in. nebular photometer telescope.

Source – Aviation Week, June 29, 1964, p 55.

Recorded – October 14, 1964.

ss90 – Manned Space Station

Cost -- \$10,000/man-hour

Discussion – a smaller, 3-man, one year orbital lifetime facility might cost approximately, \$250,000 per man-hour, considering its entire operations, including hardware, launch and operations.

24 man stations would weigh approximately 150,000 lbs, launched by Saturn 5 with capability of orbiting at least 250,000 lb of payload.

100,000 of expendable supplies.

260 mil orbit, inclination of 69 degrees pass over Cape twice daily.

Source – Aviation Week, June 15, 1964, p 74.

Recorded – October 14, 1964.

ss91 – MORL – Langley Configuration

Cost -- \$1.64 billion

Discussion – 154 in diameter with deployment capability

MORL lab -- \$490.83 million

Ferry System -- 423.85

Re-supply System -- 285.34

Facilities -- 64.82

Operations -- 74.25

Astronaut Training -- 88.76

Program Management -- 215.78

Source – Report on a System Comparison & Selection Study of MORL, Vol. III Prelim. Program Plan, Cost Appendix, September 1963, Douglas Report, SM-44618, p 4.

Recorded – October 15, 1964.

Details for above subsystems are also in the same source document and recorded on separate file cards. Contact Douglas or Heuston Consulting if required.

SS92 – Radom Orbit Spin Phased Array COMSAT

Cost -- \$40.36 million R & D.

Discussion – Development 38.86 million

Proto (2) 1.50

Total 40.36

Production/unit .75

Launch, cost/launch .24

Source – STL COMSAT Work Sheets – Cost of Alternatives, January 24, 1964,

Recorded – February 4, 1964.

Similar details are also available from the same source for Random Orbit Gravity Gradient COMSAT, Random Spin Stabilized COMSAT, Phased Orbit Spin Phased Array COMSAT, Phased or Controlled Orbit Spin Stabilized COMSAT, Phased Orbit Gravity Gradient COMSAT. Contact Heuston Consulting if required.

SS93 – Ranger Program

Cost -- \$16 million apiece.

Discussion -- Costright – prorated over the entire Ranger program of 15 flights

	1962	1963	1964
Project Management	369,000	307,000	270,000
System Analysis	3,400,000	5,038,000	5,750,000
Lunar capsule contract	4,787,000	2,372,000	10,500,000
Impact TV System Contract	7,200,000	9,950,000	3,300,000
Scientific Experim.	2,834,000	3,480,000	3,940,000
Telecommunications	3,634,000	6,140,000	63,900,000
Guid. & Control	3,805,000	6,035,000	3,420,000
Spacecraft Structures	2,782,000	3,659,000	3,420,000
Spacecraft Prop. Systems	345,000	394,000	390,000
Engineering Support	3,374,000	5,247,000	4,800,000
Spacecraft Flight Ops. Fac. Equip	--	748,000	1,870,000
Total Spacecraft	32,530,000	44,170,000	48,300,000
ATLAS-AGENA launch vehicle	30,900,000	34,800,000	42,700,000

TOTAL RANGER	63,430,000	78,970,000	90,000,000
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Source – House Appropriations Committee Hearings, 88th Congress, Part 3, p 412
Recorded – November 1, 1963.

SS94 – Mariner I, and II

Cost -- \$4 million

Discussion – Cost of 1

Mariner II – total cost \$18.5 million, including launch

(Rockets & Missiles – 6 August, 1962)

(Article, Mariner II – page 3)

Source – Los Angeles Times, July 23, 1962.

Recorded – July 23, 1962.

SS95 – Telstar

Cost -- \$50 million

Discussion – first unit cost plus R&D

Weight 170 lbs

52.7 million/170 = \$311,000/lb of payload

Cost to launch = \$2.7 million

Source -- Los Angeles Times, July 11, 1962, p 2.

SS96 – Tiros & Nimbus

Cost -- \$130 million

Discussion --

Source -- House Appropriations Committee Hearings, 88th Congress,

Recorded –

SS97 – Surveyor Program

Cost – as follows

Discussion –

	1962	1963	1964
Surveyor Lander			
Project Management	379,000	477,000	200,000
Systems Analysis	1,077,000	667,000	740,000
Spacecraft Dev. Contract	23,317,000	38,573,000	26,000,000
Scientific Exp.	4,972,000	4,624,000	6,500,000
Telecommunications	91,000	105,000	85,000
Guid. & Control	70,000	29,000	25,000
Spacecraft Structures	122,000	156,000	75,000
Spacecraft Propulsion System	69,000	68,000	50,000

Engineering Support	532,000	818,000	825,000
Space flight Ops. Facility Equip.	--	2,779,000	3,000,000
Total Lander	35,629,000	48,296,000	37,500,000
ATLAS-CENTAUR Launch Vehicle	2,309,000	11,700,000	31,800,000
Total Surveyor Lander	37,938,000	59,996,000	69,300,000
Surveyor Orbiter Proj. Management	--	--	500,000
Spacecraft Dev.	--	363,000	13,500,000
Scientific Exp.	1,196,000	1,337,000	2,000,000
Visual Inst. Subsy.	--	--	2,000,000
Total Surveyor Orbiter	1,196,000	1,700,000	18,000,000
ATLAS/CENTAUR Launch Vehicle	--	--	10,200,000
Total Surveyor Orbiter	1,196,000	1,700,000	28,200,000
Total Surveyor Lander & Orbiter	39,134,000	61,696,000	97,500,000

Source – House Appropriations Committee Hearings, 88th Congress, part 3, p 414.
Recorded – November 1, 1963.

ss98 – Biosatellite – NASA

Cost – Spacecraft = \$11.7 million

Launch Vehicle = \$12 million

Total = \$24 million for R&D costs

Source – House Appropriations Committee Hearings, 88th Congress, Part 3, p 423

Recorded – November 1, 1963.

ss99 – SYNCON Conversation

Cost -- \$11 million

Discussion – Mr. Evins – How long did the conversation last?

Seamans – 30 minutes

Ostertag – Was the \$11 million for installing the various ends of this connection?

Seamas – The \$11 million covered the satellite and the Thor-Delta vehicle, but the actual ground equipment at Kingsport, and the outfitting of the Kingsport and its operations, as well as the equipment at Fort Dix was financed by the DOD

Stay up 9 months.

Source -- House Appropriations Committee Hearings, 88th Congress, Part 3, p 519

Recorded – November 4, 1963.

ss100 – Weather Satellite Program

Cost – In FY 1962, approximately \$50.7 million

Discussion – In 1963 = 43.2 million

In 1964 = 26.2 million

Wyatt – The bulk of this money is transferred to NASA to support the operational requirements of Tiros.

Jonas – The program will cost \$100 million?

Dryden – Not the research program.

The weather Bureau, in operating satellites, operates them like they operate ships or weather stations, on the ground. They pay that cost as part of their daily collection of weather data.

Source – House Appropriations Committee Hearings, 88th Congress, Part 3, p 374

Recorded – October 31, 1963.

SS101 – SNAP-8

Cost – For 1964, it is \$15 million.

Discussion –

Source – House Appropriations Committee Hearings, 88th Congress, Part 3, p 372

Recorded – October 31, 1963.

SS102 – Communications Satellite

Cost -- \$46 million.

Discussion – Garbarini -- \$200,000 for Echo
\$1.9 million for Relay
\$4 million for Syncom
\$40 million for the advanced synchronous communications satellite, making a total of \$46.1 million.\

FY 64, Atlas-Agena launch vehicle for 3 orbital flights and one backup, \$12.5 million, 3 spacecrafts plus a backup for \$16,640,000 in Advanced Sync. Satellite Program chart.

Source – House Appropriations Committee Hearings, 88th Congress, Part 3, p 382

Recorded – October 31, 1963.

SS103 – Orbiting Geophysical Observatory

Cost -- \$170 million

Discussion – Cartright – The total development cost of that spacecraft and procurement of the nine 1,000 lb spacecraft will be in the neighborhood of \$170 million.

Space Technology Laboratories

Nine are planned.

Thomas – What will your operational costs be?

It will be covered in this \$232 million?

Cartright – The number I gave you includes operational costs, including data retrieval and data reduction.

Seamans – The figure I gave is a runout cost whereas the figures here just cover the 1964 part of that.

Thomas – How much beyond 1964 are you going?

Cartright -- \$75 million on spacecraft.

Thomas – What is your wrap-up cost?

Cartright – that was my \$168 million figure. Launched 2 a year, one in solar orbit and one in eccentric orbit.

Seamans – They run for about 40 years.

Source – House Appropriations Committee Hearings 88th Congress, Part 3, p 402

Recorded – October 31, 1963.

SS104 – Manned Orbital Laboratory

Cost – as follows

Discussion – development including construction of 2 units is estimated to cost about \$390 million.

The annual support of one lab. is approximately \$120 million.

At a cost of \$5 million per flight of a vehicle of the Atlas-Centaur type.

1965 – 1970 time period.

Source – Aero/Space Engineering, May 1960.

Recorded – June 30, 1964.

SS105 – Midas Early Warning Satellite

Cost -- \$2.3 billion to implement Midas and \$100 million for annual maintenance.

Discussion – The program originally intended to provide an additional 15 min. warning time beyond that available from the BMEWS.

By 1969 – the earliest that Midas could become operational this added warning time is not expected to justify the \$2-3 billion to implement.

Source – Aviation Week, February 3, 1964, p 33.

Recorded – June 29, 1964.

SS106 – Syncom 3, COMSAT Facilities Modification at Pt. Mugu.

Cost -- \$250,000

Discussion – paying Hughes Aircraft Company

Modification includes installation of a microwave Electronic Corp. helium-cooled maser on the 85 ft. antenna to improve quality.

Transmission Cost -- \$150/minute

Through Montreal Link

Japan Broadcasting Corp. is financing \$100,000 and radio Corp. of America is paying \$200,000 for a share in this system.

Source – Aviation Week, August 31, 1964, p 22.

Recorded – November 4, 1964.

SS107 – DoD Medium Altitude Random COMSAT

Cost -- \$165 million program.

Discussion – substantially reduced by use of the Titan 3 booster with a greater satellite payload capacity than the proven Atlas-Agena.

Fubini, deputy director of defense research and engineering estimated that DoD would have paid Com. Sat. Corp, about \$30 million a month for use of a shared system.

Source – Aviation Week, July 20, 1964, p 19.

Recorded – November 9, 1964.

SS108 – MOL Program

Cost -- \$1.5 billion

Discussion – about the amount which NASA might spend on its multipurpose station.

Source – Aviation Week, October 26, 1964, p 27.

Recorded – November 30, 1964.

SS110 – Unmanned Voyager to Mars

Cost -- \$1.5 billion

Discussion – an unmanned Voyager payload could return all information of conceivable value at a cost of \$1.5 billion.

Conservative estimates place the cost of a manned flight at \$50 billion.

Source – Aviation Week, August 9, 1965.

Recorded – September 16, 1965.

SS111 – Surveyor Spacecraft Program

Cost -- \$750 million

Discussion – supposed to cost \$500 million and now is expected to cost almost \$750 million.

Far behind schedule.

Source – Aviation Week, August 16, 1965, p 25.

Recorded – September 16, 1965.

SS112 – Surveyor

Cost -- \$725 million for 10 flights

Discussion – costs have skyrocketed to some \$350 million thus far – for indicating a probable total of \$725 million for 10 flights.

Source – Missiles & Rockets, November 1, 1965, p 46.

Recorded – December 3, 1965.

SS113 – Apollo Research Program

Cost – as follows

Discussion – North American Aviation has received \$996,000 in additional funding from Manned Spacecraft Center to investigate the capabilities of the Apollo Application synchronous, polar and lunar orbit missions. This brings total value of that contract to \$3,456,000. Results are due at MSC in January.

Source – Missiles & Rockets, November 8, 1965, p 9.

Recorded – December 3, 1965.

SS114 – Early Bird Modified

Cost -- \$14 million for 24

Discussion – Comsat had proposed to finance manufacture of ... and to supply them to the DoD on a commercial billing basis.

Source – Astronautics & Aeronautics, April 1965, p 99.

Recorded – April 26, 1965.

SS115 – Synchronous Satellite

Cost -- \$11.7 million for purchase of four.

Discussion – Communications Satellite Corporation last week filed with FCC an \$11.7 million contract for purchase of four synchronous satellites for use by NASA.

Source – Aviation Week, October 25, 1965, p 68.

Recorded – November 26, 1965.

SS116 – Voyager

Cost -- \$1.8 billion for 2 flights

Discussion – cover all hardware and spares

Provide for 2 Saturn V launches, 1 in 1973, and one in 1975.

Each Saturn V will carry 2 Voyager spacecraft mounted in tandem.

An addition to the \$1.8 billion, approximately, \$400 million will be required for costs, ground support equipment and launch costs.

It does not include the facilities costs that will be necessary for the program, which will amount to approximately \$40 million.

Source – Hearings before Committee on Aeron. & Space Sciences, Senate, 90th Congress, 1st Session on S-1296, Part 1, April 8, 9, 30, 1967.

Recorded – May 1, 1968.

SS117 – OGO Satellite

Cost -- \$13.5 million

Discussion – weight, 1350 lbs

Volume, cubic inches, 77,270

Power watts, 250

Stabilization, 3 axis

Experiments accommodation

Weight, 230 lbs

Volume, cubic inches, 23,000

Power watts, 100

Data, 64,000

Cmds, 300.

Source – Evaluation of Orbit Lab. Concept for Geophysical Research in Near Earth Environment, IIT, August 67, p 28.

Recorded – June 10, 1968.

SS118 – Sunblazer

Cost – total runout costs = \$17 million

Discussion – including the launch vehicles, which will give 2 flights.

Measure important features of the solar corona.

Source – Hearings Com. On Aeron. & Space Science, 90th Congress, 1st Session, Part 1, April 1967, p 62.

May 1, 1968.

SS119 – Mariner 1967

Cost – Total estimated to \$196 million

Discussion – includes the probe

Plus the launch vehicles and the services

Associated with the launching which are estimated at another \$20 million.

Source – Hearings Comm. On Aeron. & Space Science, 90th Congress, 1st Session, Part 1, April 1967, p 65.

Recorded – May 1, 1968.

SS120 – Apollo Applications

Cost – Runout costs through 1973 are estimate roughly at as much as \$6 billion

Discussion –

Source – Aviation Week, February 5, 1968, p 25.

SS121 – Voyager Program

Cost – well over \$2.2 billion, NASA revealed to Congress

Discussion – original figure of \$1.5 billion for the spacecraft program for the first two mission opportunities is now up to \$1.837 billion, with Saturn V launch vehicles, at \$205 million apiece, boosting this figure to \$2.2 billion.

An additional \$25 – 30 million will be needed for facilities, NASA said, plus \$50 million for 2 new 210 ft antennas.

Source – Technology Week, April 3, 1967, p 3.

Recorded – May 1, 1967.

SS122 – OAA, Grumman Orbiting Astronomical Observatory

Cost -- \$92 million

Discussion – NASA last week estimated the cost of the initial Grumman Orbiting Astro. Obs. Failure last April.

This includes costs of the spacecraft, half the development cost of spacecraft and experiments, and the cost of the Atlas Agena D launch vehicle.

Source – Aviation Week, March 27, 1967, p 11.

Recorded – April 24, 1967.

SS123 – NATO Comsat

Cost – comparable to the \$6.9 million that the UK is paying for its 2 satellites.

Discussion – NATO buy of 2 US built station-keeping, syncr. Alt. comm. sat.

Source – Aerospace Technology, November 20, 1967, p 14.

SS124 – Intelsat 3.5 for COMSAT

Cost – as follows

Discussion – Comsat estimated a \$6 million satellite development cost for the Intelsat 3.5 and a \$1.8 million procurement cost for each satellite. The Douglas Thor/Delta vehicle, which will be used in the Intelsat 3 launches would also be used for Intelsat 3.5 launches. Cost for each launch is \$5.3 million.

Source – Aviation Week, November 6, 1967, p 21.

Recorded – November 30, 1967.

SS125 – Solar Electric Propulsion Mars Orbiter Spacecraft

Cost – total Program = \$375.9 million

Discussion – as follows

	Solar Electric Spacecraft	All Chemical Spacecraft
Program Management	17.9	9.2
Design Development	93.9	66.4
Fab, Assem, Test (10 units)	251.5	113.3
Field Operations	12.6	5.6
Total Program Cost	375.9	194.5
Less	Scientific payload & lander	Space science package & lander
Cost of Sc. Payload (10 units)	626.0	163.0

Cost effectiveness ratios	\$/lb	\$/lb
Fab, assm, test dollars pay		
Load (lbs) less lander (10u)	14,000	24,300
Total prog. cost divided by		
Payload (lbs) less lander (10u)	21,000	41,600
Total prog. Cost incl. payload		
Less lander dived payload (lbs)		
Less lander (10 units)	56,000	76,5000

All costs are 1965 \$, although delivery of flight articles would not occur until 1970. In c-
- ratio, SEP refers to electronics and instruments in scientific payload (1790 lbs)

And for all chemical refers to space science package (466 lbs).

	Solar	Chemical
Total weight	9595	7800
Science Payload	4090	466
Elect. Prop.	2170	382
Structure	880	590 Power Supply (photovoltaic)
Other	balance	balance

Source – Solar Powered Electric Propulsion Spacecraft Study, Final Report,
Hughes JPL Contract No 951144, SSD 50094, p 7-1.

Recorded – May 20, 1966.

SS126 – Intelsat 4 Program for COMSAT Corp.

Cost -- \$97.2 million

Discussion – Satellites \$50.7 million, 30 million in development, 20.7 million for procurement of 5 satellites.

Launch for Atlantic service in mid 1970, followed by a launch for service in the Pacific and launch of an in-orbit space.

An additional in-orbit space would be launched in 1971. 5th satellite would be an on-ground space.

Launches, \$41 million. At approximately \$10 million a launch, this would provide for the three 1970 launches and the one 1971 launch. COMSAT said that it is now negotiating with AF for procurement of Titan/Agena vehicles.

Source – Aviation Week, November 6, 1967, p 21.

SS127 – Project ADVENT

Cost – estimated costs to completion = \$325 million.

Discussion – In May 1962, ... was cancelled after an expenditure of \$170 million when estimated costs to completion had grown from the original \$140 million to \$325 million.

The IDCSP “interim” system was substituted and the objective changed to call for a medium altitude random orbit with approximately 24-30 satellites to be launched in clusters of six using Atlas-Agena launch vehicles.

Philco won the competition to build the satellites.

Source – Aviation Week, June 27, 1966, p 26.

Recorded – May 21, 1966.

SS128 – Airborne Launch Platform

Cost –

Discussion – North American’s XB-70 studies in 1960 came up with a qualified cost-per-pound in orbit figure of \$125 for a 10,000 pound payload, less than half the cost at that time of orbiting a payload with the Atlas, the Titan, or the Saturn.

Source – Missiles/Space Daily, June 9, 1967, p 141

Recorded – June 20, 1967.

SS129 – Military COMSAT

Cost -- \$33 million for 3 launches.

Discussion – All 7 military communication satellites launched into an 18,200 n. mile circular equatorial orbit by a USAF/Martin Titan 3C are functioning satisfactorily.

Satellite apogee is 18,292 n. mi. and perigee is 18,172 n. mi.

An 8th satellite launched at the same time to explore the feasibility of gravity-gradient stabilization at very high altitudes has successfully deployed its 252 ft. long booms.

Brown emphasized that the satellites in sufficient number for 3 launches have been built at a cost of \$33 million, about 10% higher than the figure budgeted nearly 2 years ago.

The original Pentagon cost estimate for the mid-alt. system, based on 10 Atlas-Agena launch vehicles, was \$165 million of which \$60 million was for the satellites.

Source – Aviation Week, June 27, 1966, p 26.

Recorded – July 21, 1966.

SS130 – MOL Launch Vehicle Guidance Computer

Cost -- \$10 million, initial contract

Discussion – Univac beat out IBM, which had been supplying launch vehicle computers for Titan 3.

A. C. Electronics is associate prime contractor for guidance on Titan 3.

Univac computer to be used is a version of the Model 1824.

Source – Technology Week, June 27, 1966, p 3.

Recorded – August 19, 1966.

SS131 – Lunar Travel

Cost -- \$5,000 to land a pound of payload on the Moon.

Discussion – GE suggests that it will cost \$5,000 and \$100,000 per man hour to maintain a system on the lunar surface.

There, for the first year, if 12 man hours of maintenance is assumed, GE calculates a saving of \$108.8 million over filling a Lunar Module truck purely with cryogenic propellants and sending it to the Moon to supply lunar logistics vehicles and bases remote from lunar headquarters.

GE proposing a fuel production system based on the electro-analysis of water into cryogenic fuels.

Source – Technology Week, August 29, 1966, p 28.

Recorded – September 14, 1966.

SS132 – NASA's Biosatellite

Cost -- \$90 million program

Discussion – The first flight in the series – originally set for late 1965 has now slipped to this December.

Two 30 day long duration missions – originally ticketed for late 1966 and 1967 have been put off until 1968.

Two 21 day missions have also been pushed back to 1969.

The cost of the six satellite program, which was estimated at \$40 million in 1963, has now soared to \$90 million.

Source – Technology Week, October 17, 1966, p 13.

Recorded – November 10, 1966.

SS133 – Apollo Simulator

Cost -- \$9.5 million incentive contract.

Discussion – NASA MSC awarded to Gen. Prec. A Division of Link.

Source – Technology Week, December 12, 1966, p 3.

SS134 – Program 266, Satellite

Cost -- \$70 million development

Discussion – Aerojet-General/TRW.

Source – Technology Week, December 19, 1966.

SS135 – Tactical Comsat Experimental

Cost – Total development effort pegged about \$30 million.

Discussion – including launch costs.

Expected to combine UHF & SHF capabilities.

- Source – Technology Week, December 9, 1966, p 3.
Recorded – January 6, 1967.
- SS136 – Manned Orbiting Laboratory
Cost -- \$2.16 billion for total program cost
Discussion -- \$1.5 billion represents the basic contracts and the remainder the limits of cost of changes or overruns.
Douglas share of the basic contract is \$600 million.
Source – Aviation Week, December 19, 1966, p 15.
Recorded – February 1, 1967.
- SS137 – International Telecommunications Satellite
Cost – Spacecraft estimated at \$2 million per copy.
Discussion –
Source – Missiles & Space Daily, January 11, 1967, p 39.
Recorded – February 9, 1967.
- SS138 – Experimental Tactical Communications Satellite
Cost – 2 year program valued at about \$23.5 million
Discussion – AF has selected Hughes Aircraft Co. to design and build.
Hughes will provide a single satellite to be launched from the ETR aboard a Titan III-C into synchronous orbit.
Source – Technology Week, January 16, 1967, p 3.
Recorded – March 8, 1967.
- SS139 – Voyager Spacecraft
Cost -- \$450 million for each Voyager/1973 spacecraft.
Discussion – In addition to a total cost of more than \$1.8 billion for the four Voyager spacecraft, the agency (NASA) said that two Saturn V boosters used for the 1973 mission will each cost \$115 million.
The figures quoted are for launched spacecraft which means that some of the price includes the cost of on-board experiments.
Source – Technology Week, January 23, 1967, p 15.
Recorded – February 9, 1967.
- SS140 – Radio Astronomy Explorers
Cost -- \$30.9 million for four.
Discussion –
Source – Technology Week, January 23, 1967, p 15.
Recorded – March 9, 1967.
- SS141 – Small Standard Satellite
Cost -- \$18.4 million for four.
Discussion –
Source – Technology Week, January 23, 1967, p 15.
Recorded – March 9, 1967.

SS142 –X-Ray Explorer

Cost -- \$5 million for one.

Discussion –

Source -- Technology Week, January 23, 1967, p 15.

Recorded – March 9, 1967.

SS143 – Mariner/Mars

Cost -- \$107 million for two.

Discussion – for 1971 -- \$196 million for two.

Source – Technology Week, January 23, 1967, p 15.

Recorded – March 9, 1967.

SS144 – Tiros - M Satellite

Cost -- \$17.9 million each.

Discussion –

Source – Technology Week, January 23, 1967, p 15.

Recorded – March 9, 1967.

SS145 – Voice/TV Broadcast Satellite

Cost -- \$100 million for two.

Discussion –

Source – Technology Week, January 23, 1967, p 15.

Recorded – March 9, 1967.

SS146 – Nimbus, follow on

Cost -- \$140 million for four

Discussion –

Source – Technology Week, January 23, 1967, p 15.

Recorded – March 9, 1967

SS147 – Sunblazer Spacecraft Solar Probes

Cost -- \$9.5 million for five.

Discussion –

Source – Technology Week, January 23, 1967, p 15.

Recorded – March 9, 1967.

SS148 – OV-1 Satellite

Cost -- \$1.25 million

Discussion – Average over the past two buys of eight spacecraft , assuming that two OV-1 spacecraft are launched by one Atlas D.

When this figure is combined with the average sensor weight carried into orbit by these vehicles, the cost per pound of scientific instruments in orbit is about \$10,000. This figure decreases if the full 200 lb instrumented payload capability of the OV-1 is utilized.

Source – Technology Week, February 13, 1967, p 29.

- Recorded – March 21, 1967.
- SS149 – Manned Lunar Landing
Cost -- \$18-20 billion by the first landing in 1970.
Discussion –
Source – International Science & Technology, March 1967, p 31.
Recorded – March 31, 1967.
- SS150 – Intelsat
Cost -- \$31 million contract with TRW for six 1,200 circuit satellites that will be backbone of the initial global system.
Discussion – these satellites will be launched in 1968.
One is positioned over the Atlantic, one over the Pacific, and one over the Indian Ocean. Others are backup or other assignments.
We get launches through Intelsat at cost plus \$1.
There is \$1.7 million in the 1967 budget to start the \$30 million SAROS (Stationary Orbit Radio Satellite) project. It involves construction of one or two prototypes and then two operational 440 lb. spacecraft. Launch is planned for 1971.
Source – Aviation Week, February 13, 1967, p 27.
Recorded – April 5, 1967.
- SS151 – HEOS-A, Highly Eccentric Orbit Satellite for ESRO
Cost -- \$4 million for launch vehicle and services (Delta launch from ETR).
Discussion – HEOS-A weighing approximately 230 lbs.
Source – Missiles/Space Daily, March 10, 1967, p 38.
Recorded – April 5, 1967.
- SS152 – Voyager Program
Cost -- \$2.3 billion
Discussion – the basic Voyager program cost through the first two mission opportunities (4 flight missions on two Saturn V launch vehicles) will be \$1.837 billion.
Source – Missiles/Space Daily, March 31, 1967, p 113.
Recorded – April 12, 1967.
- SS153 – UK Comsat, Philco-Ford's communication satellites for UK
Cost -- \$7,621,000 contract for 2 satellites.
Discussion – from AF SSD, which will handle development for the UK.
Will incorporate station keeping capability for use at synchronous altitude.
Source – Technology Week, March 13, 1967, p 15.
Recorded – April 14, 1967.
- SS154 – TV Satellite
Cost – Initial investment = \$100 million; Annual operations = \$25 – 35 million.

Discussion – 2 synchronous satellites providing some 15 to 20 television channels each with 2 more satellites in orbit for standby purposes.

The spacecraft would provide 5 channels in each of four time zones, with extra channels available for special requirements.

The system would involve 86 initial ground stations serving the 100 major metropolitan areas. This number would ultimately grow to 225.

A ground station would be located near each television station involved.

NBC estimate \$103.4 million investment, \$19.4 million amortized over 15 year period.

Source – Missiles & Rockets, April 18, 1966, p 10.

Recorded – May 3, 1966.

SS155 – Domestic TV Distribution System for the Satellite

Cost -- \$100,000 each for 80 small stations for the principal TV market.

Discussion -- 3 to 10 larger stations (\$3 to \$4 million each).

Source – Missiles & Rockets, May 9, 1966, p 8.

Recorded – June 10, 1966.

SS156 – FCC COMSAT

Cost – as follows

Discussion – Initial cost estimate for the first phase, says AT&T, would be about \$100 million, with eventual costs in 1980 about \$340 million.

Source – Technology Week, January 7, 1967, p 13.

Recorded – March 7, 1967.

SS157 – Domestic Satellite System

Cost -- \$100 million

Discussion -- \$100 million

To provide the US with telecommunications services of all types – television, radio, telephone, teletypewriter.

A system drawn by Comsat engineers, which would be operational in about 3 years, would include 4 large synchronous spacecraft and a network of 225 ground stations. The satellites would have a 20 – television channel capacity – or about 20 times Early Birds capacity of one television channel or 240 voice channels.

Major part of the initial \$100 million investment would be ground stations and connecting links. Satellites would cost an estimated \$2 to \$3 million each.

Annual operating cost is estimated at \$25 – 35 million.

Total present annual payment by the 3 networks (NBC, American Broadcasting, and Columbia) to AT&T for interconnections is approximately \$55 million.

System of 6 satellites.

Annual operating cost was estimated at \$194 million. Ground facilities would include 3 major permanent stations and a network of mobile stations.

Source – Aviation Week, April 18, 1966, p 27.

Recorded – May 9, 1966.

SS158 – Nimbus, E & F

- Cost – are expected to cost \$70 million
Discussion – of which \$5 million is being requested for FY 168.
Source – Technology Week, April 10, 1967, p 19.
Recorded – May 2, 1967.
- SS159 – Manned Air Force Satellite
Cost -- \$2.2 billion, total estimated cost
Discussion – The estimate present to the house Armed Services Appropriations Subcommittee in March and just made public, reveals a \$700 million increase in the predicted total costs of the R&D program since August 1965, when Douglas Cor. Was selected as the prime contractor. At that time, total cost of the seven-flight program was estimated at \$1.5 billion.
In August 65, DoD estimated that manned MOL flights would begin in med-1968. Thus, in less than 6 years, the program cost has gone up by \$700 million and the flight schedule has slipped by about 2 years, and possibly even more.
Source – Technology Week, May 8, 1967, p 14.
Recorded – May 15, 1967.
- SS160 – IDCSP, Initial Defense Communications Satellite Program
Cost -- \$7.2 million contract for eight more.
Discussion – ordered by SAMSO from Philco-Ford for a replenishment launch in the second quarter of 1968.
Brings to 34.
Source – Aerospace Technology, August 14, 1967, p 13.
Recorded – September 15, 1967.
- SS161 – NAVSAT, Navigational Satellite Receiving Equipment.
Cost -- \$1,000 - \$5,000.
Discussion – providing location information to ships and aircraft to within 0.1 mile and at a user cost of \$1,000 - \$5,000.
NAVSAT under study by NASA's Electronics Research Center.
3 contractors involved in the study phase.
TRW disclosed details of its preliminary design. 16 of the 212 lb satellites would be deployed in sync. orbit so that 6 would be visible to any potential user within a band 65 degrees above and below the Equator.
Source – Aviation Week, August 14, 1967, p 10.
Recorded – September 15, 1967.
- SS162 – Program 612, a new recon. satellite system
Cost -- \$350 million value of program
Discussion – AF has let a letter contract to Lockheed Missiles and Space Co. The program would eventually complement the integrated sensor satellite developed by Aerojet General and TRW.
Source – Aerospace Technology, August 28, 1967, p 3.
Recorded – September 21, 1967.

- SS163 – TTS Satellite, Test and Training Satellite for NASA-MSF Network
 Cost – target cost of \$495,000.
 Discussion – A recent cost plus incentive fee award to TRW calls for delivery of 2 octahedron-shaped (bottom to bottom pyramids).
 First spacecraft is scheduled for a piggyback launch in December aboard the Delta rocket used to launch the Pioneer-C spacecraft.
 One TTS will be orbited at a time, the first having a predicted seven months orbital life time.
 Source – Aerospace Technology, August 28, 1967, p 11.
 Recorded – September 21, 1969.
- SS164 – ADCSP, Advanced Defense Communications Satellite Program
 Cost -- \$500 million
 Discussion – a tentative plan for nine synchronous satellites and 250 ground terminals, at a 5 year cost estimated at \$500 million, has been shelved or at least modified by a search for lower cost alternatives in a stretched out time period.
 Source – Aviation Week, September 4, 1967, p 18.
 Recorded – September 25, 1967.
- SS165 – Lunar Orbiter spacecraft Total Program
 Cost -- \$210 million
 Discussion – with about \$160 million for the spacecraft
 \$40 million for the launch vehicles.
 Source – Aerospace Technology, September 11, 1967, p 18.
 Recorded – September 12, 1967.
- SS166 – Comsat Domestic Satellite
 Cost – as follows
 Discussion – Satellite segment = \$35.7 million, including \$15 million for R&D.
 Total ground segment = \$20 million plus \$2 million for spares and transportable transmitters – would be divided.
 Two major stations near Los Angeles and New York, each equipped with two 85 ft antennas, \$117 million.
 Two stations, each equipped with 42 ft antennas, \$1.63 million. These would be located in the Washington – Oregon and Tennessee – Alabama – Georgia areas.
 30 receive only stations for TV distribution, \$5.1 million. 16 of these with 32 ft. antennas would be located in the Pacific time zone, and 14 with 25 ft antennas would be located in the Mountain time zone.
 Source – Aviation Week, September 25, 1967, p 20.
- SS167 – OV-1, Scientific Satellite
 Cost -- \$4,330,000 contract for 4 additional satellites
 Discussion – GD/C received contract.
 OV-1 satellites no 15, 17, and 19, will be built by Convair
 OV-1-16, a 24 in. sphere weighing 600 lbs will be supplied by the AF Cambridge Research Laboratory.

Source – Missiles/Space Daily, September 7, 1967, p 16.
Recorded – October 25, 1967.

SS168 – IDCSP, Initial Defense Communications System

Cost – through R&D = \$140 million

Discussion – this includes the initial studies that were made.

Includes ground stations.

Includes certain experimental work

\$55 million related to space born portion.

Philco portion is only about \$25 million of that remainder for job of fitting satellites – of modifying the booster to take care of the satellite. You have the gravity gradient experiments. You have system contractor who is planning the integrating.

About \$75 million relates to the ground portions. Actual procurement of 26 ground stations. \$10 million for DCA'S integration.

General Starbird.

Source – Hearings, Committee on Aeronautics and Space Science, US Senate, 89th Congress, 2nd Session, January 25-26, 1966, p 19.

Recorded – July 1, 1966.

SS169 – Apollo Communications Satellite

Cost -- \$2.9 million each

Discussion – Hughes is building four Apollo satellites under a contract of \$11.7 million. One vehicle is to be retained as a backup and one will be used for ground tests.

Enlarged version of Early Bird.

Weigh 170 lbs in orbit after its solid propulsion apogee motor fuel is expended.

24 hours eq. orbit.

56 in in diameter

80 w of dc power after 5 years of operation.

Source – Aviation Week, January 17, 1966, p 80.

January 31, 1966.

SS170 – TRW COMSAT

Cost -- \$30 - \$40 million for 6 to 9 satellites

Discussion – The award includes options for up to 24 satellites for use in the global system, expected to be operational by 1968.

The 234 lb satellite would be spin stabilized, with the spin axis normal to the orbital plane, and would provide 1,200 high quality, two way voice channels.

Required operational life is 5 years minimum. The TRW Systems satellite will be cylindrical, 56 in in diameter and 37 in high. They would be launched in groups of 4 by an Atlas-Agena booster.

Source – Missiles & Rockets, December 20, 1965, p 19.

Recorded – January 26, 1966.

SS171 – TRW COMSAT

Cost – for the first six, is estimated at \$36 million for each satellite.
Discussion – cost on the remaining 18 would be graded downward.
The satellites would be cylindrical – 56 in in diameter and 37 in high – and weigh 234 lbs.
Source – Aviation Week, December 20, 1965, p 22.
Recorded – January 22, 1966.

SS172 – Reusable System Capable of Placing a 10,000 lb Plus 10 Men in Orbit

Cost – 1 billion
Discussion – Von Braun said MSFC studies indicate that development of a reusable system capable of placing a 10,000 lb payload plus 10 men in orbit would cost about \$1 billion.
If it were designed to perform one mission per week and be equal to 50-100 flights, net payload-to-orbit cost might be lowered to less than \$50 per lb. he predicted.
Source – Missiles & Rockets, November 8, 1965, p 16.
Recorded – December 21, 1965.

SS173 – Synchronous Communications Satellite

Cost -- \$11.7 million for 4 satellites.
Discussion – 2 are for backup.
Contract with Hughes Aircraft Co.
Under NASA's agreement for pay as much as \$8 million damages if a contract were not concluded. Comsat entered an \$11.7 million contract with Hughes.
The satellites will link five ground stations and three ships.
Source – Aviation Week, April 4, 1966, p 33.
Recorded – April 11, 1966.

SS174 – LEM Ground Equipment to Support the Comm. Sat. of Apollo lunar ex. version

Cost -- \$11 million
Discussion – Grumman Aircraft Engineering Corp., awarded Radio Corp. of America.
And for rendezvous and landing radar systems.
Source – Aviation Week, March 28, 1966, p 37.
Recorded – April 8, 1966.

SS175 – Gemini Computer

Cost -- \$2 million
Discussion – The study to enlarge the computer's memory capacity without alternation to the computer was undertaken 2 years ago by MSC. IBM was awarded a \$2 million contract in June, 1964, to develop a digital magnetic tape recorder and necessary software. The first of 5 flight units was installed Gemini 8 last month.
Source – Missiles & Rockets, February 21, 1966, p 12.
Recorded – April 8, 1966.

SS176 – Venus-Sun Dual Mission

Cost -- \$5 million about

Discussion – Only one launch vehicle would be required studied by TRW Systems Group.

A Venus swing-by trajectory for Pioneer that would take the spacecraft close enough to the Sun to perform useful explorations of both bodies.

Pioneer is a 140 lb cylindrical spacecraft with a diameter of 37 inches and a height of 35 inches.

First of the present 4 planned flights was launched December 16 and has completed 45 days initial operations without trouble.

TRW will be earning a bonus of \$2,000 per day for subsequent 45 days of successful space operations drops to \$1,000 next 90 days.

Source – Missiles & Rockets, February 21, 1966, p 39.

Recorded – April 8, 1966.

SS177 – Apollo Command & Service Modules

Cost -- \$2.2 billion

Discussion – agency announced January 21 that it had signed a contract conversion with North American Aviation, Inc., for development of the Apollo Command & Service Modules, bringing total cost to \$12.2 billion.

Source – Missiles & Rockets, February 21, 1966, p 10.

Recorded – April 8, 1966.

SS178 – Jupiter Probe with Modified Pioneer

Cost -- \$30 million per year.

Discussion – using a modified Pioneer spacecraft or a new spacecraft powered by electrical propulsion.

Estimates that the earliest it could fly would be 1970.

Source – Missiles & Rockets, February 21, 1966, p 14.

Recorded – April 8, 1966.

SS179 – LEM, Apollo Lunar Excursion Module

Cost -- \$1.42 billion for development

Discussion – together with the \$400 million already paid to the firm under the earlier cost-plus-fixed-fee award, the new contract will push the total cost of the LEM development to \$1.42 billion.

Source – Missiles & Rockets, February 21, 1966, p 10.

Recorded – April 8, 1966.

SS180 – AOSO, Advanced Orbiting Solar Observatory Program

Cost -- \$30 million

Discussion – now appears to have little hope of resuscitation

\$20 million is non-recoverable, NASA told Congress.

Source – Missiles & Rockets, February 28, 1966, p 7.

Recorded – March 11, 1966.

SS181 – Apollo Applications.

Cost -- \$3 - \$ million of NASA's FY 66 funds.

Discussion -- Stable Platform and Sensors for Apollo Applications Program for Telescopic Experiments.

Design Study.

Source – Missiles & Rockets, February 28, 1966, p 7.

Recorded – March 11, 1966

SS182 – Voyager Program

Cost -- \$1.5 billion

Discussion – Funding of the spacecraft portion of the Voyager program amounts to \$3.5 million through FY 66, Cortright said, with no funds actually going to the capsule portion. FY 66 spacecraft bus funds will also cover work done in FY 67, but the capsule will receive funding of \$2 million.

Cortright estimated that FY 68 funding for Voyager would reach \$7 million for the spacecraft and \$9 million for the capsule. The committee criticized this low level of funding in the light of the probable ultimate cost of the program of more than \$1.5 billion.

Source – Missiles & Rockets, February 28, 1966, p 9.

Recorded – March 14, 1966.

SS183 – Surveyor Improvement Program

Cost -- \$27.5 million in FY 66 funds.

Discussion – includes upgrading of the transmitters, klystron power tubes, telemetry calibration, tape reader reliability and strengthening of electronic part qualifications tests.

Funds of r Block II Surveyor were outlined for the committee as running to \$96.3 million for the spacecraft and \$45 million for launch vehicles for the three missions.

Source – Missiles & Rockets, February 28, 1966, p 9.

Recorded – March 14, 1966.

SS184 – Surveyor Spacecraft

Cost -- \$496 million for 17, original estimate.

Discussion – now the projection for only the seven engineering versions and their launch vehicles is \$563 million.

Three later operational surveyors, each with a 132 lb six instrument payload, together with launch vehicles, if approved, would cost an additional \$155 million. Initial 7 Surveyors will weigh about 2,200 lbs when separated from the launch vehicle.

10 ft tall and 14 ft across the base with legs extended.

Source – Aviation Week, March 28, 1966, p 82.

Recorded – April 8, 1966.

SS185 – Mariner, Probe capability in 1966 Mariner shot.

Cost -- \$30 million or more.

Discussion – such a probe, Cortright, said, would give much better information on the Martian atmospheric pressure and density.

Cost associated with it was the prime reason for ruling against the idea.

Source – Missiles & Rockets, February 28, 1966, p 9.

Recorded – March 14, 1966.

SS186 – Mercury Training for the 7 Mercury astronauts.

Cost -- \$729,043 each

Discussion – not including services such as flight training provided by the AF.

Estimates of the total training cost between mid-1963 and mid-1970 for the present 33 astronauts and about a dozen more to be selected range to \$90 million.

Source – Aviation Week, February 28, 1966, p 15.

Recorded – March 14, 1966.

SS187 – TOS, Tiros Operational Satellite

Cost -- \$22.5 million for three new TOS's = \$7.5 million each.

Discussion – a total of \$22.5 million has been allocated for the satellites and it is expected that RCA will be named to build them as a sole source selection.

The new satellites will combine the 2 camera systems now flown separately.

These are the ATT direct readouts and the AVCS systems, which will be able to store data gathered from a full orbit before it is transmitted back to Earth.

Name of TOS recently changed to ESSM (Environmental Science Services Administration Satellite).

Source – Missiles & Rockets, January 31, 1966, p 30.

Recorded – February 14, 1966.

SS188 – TIROS Launch

Cost -- \$5 million

Discussion – Boland – You anticipate launching five?

Dryden – Yes

Each of the five flights will be different.

One of them will be in a polar orbit. Another one will be in a high eccentric orbit.

With one of them we are going to experiment with direct read out so with relatively simple equipment on the ground it is possible to read out a few pictures as the TIROS goes overhead without it having to go to a central data processing operation.

Seamans – NASA has 5 R&D TIROS and in addition, there are two being funded by the Weather Bureau for a total of seven.

Garbarini – TIROS VI up about 11 months.

TIROS VI was up about 10 ½ months before it failed.

Boland – How many in orbit at this moment?

Garbarini – 2 at this moment and still operating out of 7.

Source – House Appropriations Committee Hearings, 89th Congress, Part 3, p 375.

Recorded – October 31, 1963.

SS189 – TOS System

Cost – Annual Cost = \$31,000,000

Discussion – The following is a breakdown of the estimated annual cost to maintain the TOS system after it is established. This does not include system improvements.

Spacecraft (4)	\$10,000,000
Launch vehicle & launching (4)	\$13,600,000
Operations of command & data acquisition stations and com.	\$4,100,000
Data processing, analysis, and archiving	\$2,400,000
Technical support provide by NWSC & NASA	\$900,000
Total	\$31,000,000

Source – NASA Authorization, FY 66, Hearings Comm. Aeron. & Space Sciences, Senate, 89th Congress, 1st Session, March 1965, Part 1, p 425.

Recorded – March 22, 1966.

SS190 – Surveyor

Cost – now NASA says it might be \$760 million

Discussion – the Surveyor testimony the other day revealed the original cost was about \$495 million, they then raised it to \$620 million, and now NASA says it might be \$760.

Source – NASA Authorization, FY 66, Hearings Committee Aeronautics and Space Science, 89th Congress, 1st Session, Part 1, March 65, p 234.

Recorded – March 22, 1966.

SS191 – GT-3 Flight (GEMINI)

Cost – Total system cost of \$40.0 million

Discussion – including spacecraft, booster, astronaut and other training, ground support, recovery operations, etc.

The total system (GEMINI, R&D) cost of the GT-3 flight approximates \$40.0 million. This includes the estimated cost for fabrication of the GEMINI spacecraft (\$25.0 million) and GEMINI launch vehicle (\$10.0 million), and operations support (\$3.5 million) for the DGT-3 flight. This does not include development costs or the cost of facilities and ground support equipment.

Source – NASA Authorization, FY66, Hearings Committee Aeronautics & Space Science, 89th Congress, 1st Session, March 65, p 1001.

Recorded – March 22, 1966.

SS192 – Gemini Program

Cost – Total program has topped \$1.2 billion runout costs set in FY64.

Mueller said the reason was technical problems with fuel cell development, spacecraft thrusters and booster actuators.

Source – Missiles & Rockets, March 7, 1966, p 10.

Recorded – March 29, 1966.

SS193 – Apollo-ATM, Applications Program (AAP) Apollo telescope mount (ATM)

Cost -- \$80 million.

Discussion – Selection of a NASA Center to handle the program has been made by NASA HQ, will be announced shortly.

Meanwhile, Goddard Space Flight Center will direct the project.

Manned Spacecraft & Marshall space Flight Center also had been in the running.

Total program involves 3 flight units and a prototype.

Since the submission of the FY67 budget request to Congress, he indicated the Agency has made some adjustments leading to an item of \$3.7 million for the ATM. This included \$2.7 million recovered from the cancelled Advanced Orbiting Solar Observatory program and \$1 million from the Manned Space Sciences Program.

Source – Missiles & Rockets, March 7, 1966, p 12.

Recorded – March 27, 1966.

SS194 – Mars Probe, Landing Probe on the Mariner Mars 1969 Mission

Cost – Total cost about \$30 million; \$20 million of this need in FY 67 budget.

Discussion – First estimates by Avco Corp., which studied the problem for Ames Research Center, indicated that the probe could be developed at a cost of from \$13 to \$15 million. However, an intensive study at JPL, Mariner 1969 program manager Harris Schurmeier told the subcommittee, brought the estimate up to about \$25 million. An additional \$5 million, he said, would go to the fly-by spacecraft equipment, such as communications receiver, antenna, data storage and processing, and modifications to structure. About \$5-\$8 million of the cost could be ascribed to the sterilization effort, he said.

Avco study, with which Ames concurred, estimated the weight of the landing capsule at 40-50 lbs, with the probe and sterilization canister adding up to 108 lbs.

Source – Missiles & Rockets, March 7, 1966, p 13.

Recorded – March 29, 1966.

SS195 – ATS, Applications Technology Satellite

Cost -- \$101 million project

Discussion – Hughes developing the spacecraft.

General Electric developing the gravity gradient.

Atlas-Agena D boosters will be used.

Goddard plans to launch ATS-B, the first applications satellite, in December. It will have a synchronous orbit, weigh 1,550 lbs and be spin-stabilized.

Horizon-to-horizon pictures of Earth experiments.

ATS-B will also carry an ion engine experiment, a VHF experiment involving communications between a/c and ground terminals via the satellite, and a phased-array antenna to obtain a directional antenna.

Source – Missiles & Rockets, March 7, 1966, p 22.

Recorded – April 6, 1966.

SS196 – Space Trip Costs to Mars.

Cost – as follows

Discussion – a brief vacation at a resort hotel in space, according to a learned conference here last week, would cost no more than a round trip ticket to Japan.

- Estimated cost for a single person on a 24 hour round trip in the year 2001 is \$1,250 – if 200 persons signed up. Anyone who wants a seat on the Mars express – counting on 20 as an excursion group – would have to pay \$70,000 and take an 11 months leave of absence, according to speakers at NASA's 5th Intercenter and Contractors Conference on Plasma Physics.
Source – Aviation Week, May 30, 1966, p 25.
Recorded – June 20, 1966.
- SS197 – MOL, Manned MOL Flights
Cost -- \$50-60 million each
Discussion –
Source – Missiles & Rockets, May 30, 1966, p 24.
Recorded – June 21, 1966.
- SS198 – Program 266
Cost – Development effort = \$10-\$100 million.
Discussion – would weigh + 1,600 lbs about.
To gather data for the follow on multipurpose program.
DoD has also embarked on a project with the Applied Physics Lab to use a spacecraft, initially intended as a backup for gravity gradient satellite launch, as a test bed to gather data on subsystem performance and integration in a multipurpose design.
The multipurpose program would combine early warning, meteorological, and nuclear detection sensors in a single synchronous altitude satellite program.
Development effort for this satellite could cost between \$100-\$150 million over a 2-3 year period beginning in late 1960 or early 1970.
Source – Missiles & Rockets, May 30, 1966, p 38.
Recorded – June 21, 1966.
- SS199 – Synchronous Satellites
Cost -- \$31.9 million contract for 6.
Discussion – 1st operation satellite is due for delivery 22 months from the effective start.
Source – Aviation Week, May 2, 1966, p 26.
Recorded – May 26, 1966.
- SS200 – Dynasoar Project
Cost – some \$400 million before its cancellation in December 1963.
Discussion –
Source – Missiles & Rockets, May 9, 1966, p 13.
Recorded – June 10, 1966.
- SS201 – ORL, Orbiting Research Laboratory Package
Cost – price tag for a 15 flight program,
Discussion – IBM report.
Carrying 99 experiments

- Was estimated at \$693 million for the experiments themselves and \$176 million for two new supporting facilities.
Added to this would be the cost of the 15 launch vehicles (7 Saturn 1B's and 8 Saturn V's) and the Apollo spacecraft.
Source – Missiles & Rockets, May 16, 1966, p 47.
Recorded – June 10, 1966.
- SS202 – Lifting Body, SV05P – USAF's Pilot Program Lifting Body
Cost -- \$1 million, 15 months contract for Pilot nears fiscal negotiations.
Discussion – Martin Co., for Systems Command Aeronautical Systems Div.
Weight of Prime Vehicle, 890 lbs.
Prime spacecraft includes equipment trusses and the equipment beam weighs 125 lbs., Gross structural weight = 149 lbs, Basic body heat shield = 101 lbs.
Source – Aviation Week, May 16, 1966, p 67.
Recorded – June 10, 1966.
- SS203 – Intelsat – 1968 global system of Intelsat
Cost – Total cost of establishing on a profit making basis = \$130-150 million.
Discussion – this compares with the estimate of \$200 million a year ago.
The reduction is primarily due to the successful performance of the Early Bird satellite.
Source – Aviation Week, May 9, 1966, p 32.
Recorded – June 10, 1966.
- SS204 – AOSO, Advance Orbiting Solar Observatory
Cost -- \$142 million for 4 AOSO flight vehicles.
Discussion – Cortright compared the \$80 million figure (for the Apollo Telescope Mount program) to the estimate of \$142 million for 4 AOSO flight vehicles.
(\$124 for AOSO-\$30 and OSO-\$94)
Source – Missiles & Rockets, March 21, 1966, p 16.
Recorded – May 6, 1966.
- SS205 – ATM, Apollo Telescope Mount
Cost -- \$48 million
Discussion – The estimated \$80 million cost of the program will cover 3 flight units and one prototype model.
The ATM could fly so early as 1968, when AAP flights are expected to begin using launch vehicles and spacecraft left over from the Apollo lunar-landing program.
The relative high cost of the program is caused by the intricate and exact stabilization that will be required to provide the pointing accuracy needed by an orbiting telescope. It will also have a manual override.
NASA is requesting \$37 million for ATM in its Fiscal 1967 budget and is expected to use another \$3.7 million recovered from the cancelled Advanced Orbiting Solar Observatory (AOSO) program to fund the project.

The ATM probably would constitute $\frac{3}{4}$ of the mission and that any price estimate must include launch vehicle costs, including Saturn 1B and the Command and Service Module costs, which are not part of the \$80 million estimate.

Source – Missiles & Rockets, March 21, 1966, p 16.

Recorded – May 6, 1966.

SS206 – Apollo Communications

Cost -- \$150 million

Discussion – NASA will lay out about \$150 million or more for Apollo communications over a 3 year period, including the underwriting of most of the costs for a new satellite communications system to be build by Comsat, modifications of ship terminals and conventional backup communications. Some \$27.9 million of this is involved in the Comsat contract, but does not include changes to be paid for the use of the foreign ground stations, which are expected to raise the total price for the Government to about \$40 million for 3 years.

Source – Missiles & Rockets, March 21, 1966, p 14.

Recorded – May 6, 1966.

SS207 – ALSEP, Apollo Lunar Surface Experiments Packages

Cost -- \$17 million

Discussion – The space agency is negotiating a contract with Bendix Corp. to provide four ALSEP's.

The cost plus incentive fee award is expected to total approximately \$17 million. Bendix was one of 3 firms which did initial studies on ALSEP under six month, \$500,000 contracts.

Source – Missiles & Rockets, March 21, 1966, p 11.

Recorded – May 6, 1966.

SS208 – Pioneer Venus, Pioneer Probes to Explore Venus

Cost -- \$10 million.

Discussion – could replace Mariner 1967 Venus shot

The project would add 6th spacecraft to the Pioneer program.

Development time 18 months.

Total cost including launch vehicle.

The weight of the spacecraft would stay even or rise slightly about the current 140 lb payload.

Boosted by Thrust-Augmented Delta.

Source – Missiles & Rockets, April 18, 1966, p 13.

Recorded – May 3, 1966.

SS209 – Mercury

Cost -- \$351.1 million

Discussion – Mr. Holmes – In November 1959, cost was estimated at \$293 million for research and development, and \$53 million for the tracking network.

At that time our inhouse or institutional expenses were separate. That gave a total of \$346 million.

Source – House Hearings, Subcommittee on Manned Space Flight of Committee on Science and Astronautics, 87th Congress, 2nd Session, HR 10100, March-April 1962, Part 2, p 274., NASA 63.

Recorded – November 13, 1963.

SS210 – Intelsat 4 Satellite.

Cost -- \$140-150 million for 4 or 5 satellites and launch vehicles.

Discussion – Comsat Corp., the US Intelsat participant wants the Intelsat 4 launches to start by mid-1970, - the same time the new super capacity transatlantic Mediterranean area cable network is scheduled to start operations. Capacity of the Intelsat 4s will be 6,000 or more circuits.

Source – Aviation Week, June 10, 1968, p 15.

Recorded – June 29, 1968.

SS211 – Unmanned Exploration of Mars as proposed by NASA

Cost – runout costs as follows

Discussion – Mariner Mars 1969 = \$127.6 million for the pair of spacecraft to be launched toward flyby observations of the planet, and \$20 million for the two Atlas Centaur launch vehicles.

Mariner Mars 1971 = \$86 million for a pair of orbiters, and \$20 million for the launch vehicles for each.

Mariner Mars 1973 = \$347 million for the two orbiters and two landers, for which there is no firm definition. NASA estimates costs of the 2 Titan 3 type launch vehicles with a Centaur upper stage to be \$38.4 million.

Source – Aviation Week, February 25, 1968, p 22.

Recorded – June 2, 1965.

SS222 – Canada Comsat

Cost – 3 satellites – one in orbit – one in orbit backup – one on ground backup
Range from \$40 million to \$75 million, including research and development.

Discussion – 2 large terminals to transmit and receive all types of signals, television, telephone, data – costing about \$3.5 million each.

5 smaller terminals for more remote areas to perform essentially similar functions
Costing about \$1.2 million each

30 receive only terminals for television reception costing about \$100,000 each.

Source – Aviation Week, April 15, 1968, p 27.

Recorded – May 18, 1968.

SS223 – Combined Navigational Satellite System

Cost – price at something less than \$100,000

Discussion – Honeywell Aerospace-Florida Division
Weigh approximately 80 lbs.

The Update Geo Navigator consist of 4 elements

Nav-Sat receiver = 28 lbs

Digital computer = 25 lbs
Control display = lbs
Power supply = 28 lbs
Source – Aviation Week, January 8, 1968, p 75.
Recorded – April 27, 1968.

SS224 – Lunar Module

Cost – jumped in price from an estimate of \$1 billion to about \$1.8 billion.
Discussion – Aviation Week, April 22, 1968, p 15.
Recorded – April 27, 1968.

SS225 – Apollo Manned Flight Program

Cost -- \$22.7 billion
Discussion – If the lunar landing can be accomplished on that flight (1st manned-rated Apollo Block 11 spacecraft will be delivered to Cape Kennedy late this year and launched 3 months later (in the first quarter of 1968). The 11th of the 15 Saturn V flights in the program will take place toward the end of calendar year 1968), or an earlier one, the landing will be made in this decade and the total cost up to that point will be within the \$22.7 billion estimate of runout costs supplied to your committee last year.
Source – Missile/Space Daily, May 10, 1967, p 36.
Recorded – June 1, 1967.

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