Then and N

Space Related Research

The Digital Topographic Support System is an integrated electronic (computerized) system that produces annotated image maps.

Photo courtesy U.S. Army Engineer Research and Development Center

MATERIEL SOLUTIONS

The Army Space Initiatives Study group struggled with how to define Space capabilities. They chose a broad interpretation which allowed inclusion of systems that used Space but which many people would not call Space systems per se. This resulted in a long list of materiel solutions that at first glance have little to do with Space at all. However, Space is either an enabler of these capabilities or vice versa and the Study team felt that they needed to be mentioned to avoid building a "stove-piped" Space wish list. This also reflected the prevailing view of the Study team that a broad interpretation of "Space" better postured the Army to assert its role and contributions to and use of Space capabilities.

The Army Space Initiatives Study categorized materiel solutions by both cost (what was thought reasonable with respect to "payoff" at the time) and time-frame for production. In order to maintain clarity this paper follows that same categorization. To incorporate non-materiel solutions and to support research, a separate Space-Related Research line was included in all time periods.

Level 1 items – considered the minimum essential items to procure.

Level 2 items – considered to provide substantially enhanced tactical capability and significant technological advances.

Level 3 items – considered highly desirable items but believed more expensive than the Army could afford.

The time-line was broken down as follows:

Near-term was FY86-FY92
Mid-Term was FY93-FY03
Far-Term was FY03-FY25

Global Hawk (RQ-4A), an unmanned aerial vehicle touches down on a runway. The first RQ-4A flew in 1998 and has even seen service in Operation Enduring Freedom.
U. S. Air Force photo

THEN AND NOW LEVEL 1 ITEMS:

Digital Topographic Support System:

The Digital Topographic Support System was originally envisioned as a capability to exploit Digital Topographic Elevation Data from what is now the National Geospatial Intelligence Agency and make terrain environmental products and analysis available to the All Source Analysis System being built for the G-2

Then: In last stages of development.

Now: Successfully fielded with variants and expanded capabilities.

Leased Satellite Communications:

The Defense Information Systems Agency in conjunction with Army and other Services implements leases for SATCOM services. Joint Chiefs of Staff adjudicates which Combatant Commands receive what amount of available service when multiple Combatants Commands have requirements for the same services.

Then: Leased satellite communications were decentralized and the Study team advocated the Army making contingency lease arrangements worldwide

Now: In mid-1990s, in response to the congressionally directed Commercial Satellite Communications Initiative, many of the Department of Defense's leasing of commercial SATCOM were centralized through Defense Information Systems Agency.

Remotely Piloted Vehicles/ Unmanned Aerial Vehicles:

Space communications and global positioning system, position, navigation and terrain allows the flight and indeed launch of hell fire missiles by "pilots" in the Continental U.S. flying aircraft in combat theaters half a world away.

Then: The Study advocated pursuit of a series of aggressive programs to develop a mature family of remote and unmanned systems. This meant Aquila and Amber programs at the time. These systems were viewed as part of a mixed team of ground, airborne, and satellite systems necessary to support combat operations. It was envisioned that these platforms would have a satellite link to move data beyond line-of-sight.

Now: RPV/UAV systems are ubiquitous across the battlefield from very sophisticated Global Hawk to hand launched microcraft. Space is an integral part of command, control and data movement for many of these systems.

Advanced Computer Technology:

Although government involvement helped, the computers and software of today are driven by the explosive growth in commercial uses of hardware and the video, business, and gaming software developed for mass markets.

Then: The Study advocated both hardware and software efforts to develop "tactical supercomputers." Various contemporary government developments were envisioned as the route to this capability.

Now: Computers with processing power and sophisticated software far exceed the dreams of the Study team.

Artificial Intelligence Technology:

A futuristic concept (like an anti-gravity car in every garage) is simple to envision and describe, but poses practical difficulties that make its implementation doubtful before the end of the Study time frame.

Then: The Study advocated efforts to develop artificial intelligence for tactical applications including robotics, image understanding, natural language processing and optimal search strategies.

Now: Artificial Intelligence retains potential benefit on the battlefield; however, development of Artificial Intelligence capabilities has generally been less than envisioned by the Study team.

Counter-Terrorism/Low Intensity Conflict System:

Rapid fielding of small communication and computer capabilities.

Then: The Study advocated several systems including lightweight computers, lightweight satellite communications, remotely monitored sensors, millimeter wave physical security systems, and Remotely Piloted Vehicles for a variety of tasks including downed pilot extraction and Special Operations Force team resupply.

Now: These items have come into existence for the most part. Particularly since Desert Storm, the use of remotely piloted vehicles has expanded, although some of the missions such as downed pilot extraction have not come to pass.

Space-Related Research:

The program of Space research and development was centered on Army Materiel Command (Laboratory Command) Army Space Technology Research Office and had about $3M in FY87. The budget never grew and by 1991 was essentially zeroed. The function was transferred to Space and Strategic Defense Command in Crystal City, Va., in 1992. Eventually, the functions were moved to Space and Strategic Defense Command Huntsville and Space funds gradually grew to about $19M. Substantial Space related funding is being executed by Communications-Electronics Research Development and Engineering Center and others but these funds are typically labeled for communications or other functions.

Then: The Study advocated a modest $3M program in FY87 rising to $11M by FY90 to do Space technology integration in support of future developments.

Now: Although a modest program exists it does not have the robustness envisioned by Army Space Initiatives Study.

Single Channel Objective Tactical Terminal /MILSTAR Program:

The Single Channel Anti-jam Man Portable (346 fielded starting in the late 1980s) provides single operator, Extremely High Frequency capability with all satellite low-data-rate payloads. It is used extensively where remote operations and limited local infrastructure do not support non-satellite communications.

Then: The Study advocated the Single Channel Objective Tactical Terminal be fielded as soon as possible.

Now: Single Channel Objective Tactical Terminal was never fielded because it was too big and heavy, required three dedicated operators, and took lots of time to install. Fort Monmouth took its learning experience from it and exploited

A futuristic concept (like an anti-gravity car in every garage) is simple to envision and describe, but poses practical difficulties that make its implementation doubtful before the end of the Study time frame.

the rapid development in electronics to instead field the Single Channel Anti-jam Man Portable radio and subsequently the Secure, Mobile Anti-jam, Reliable, Tactical Terminal.

Improved Space-Based Communications (Mid-term item FY93-03):

Rapid growth in user requirements means that currently over 80 percent of communications in support of Central Command activities are on leased commercial satellites. Fielding of the next generation of Department of Defense communications satellites (Wideband Global Satcom) had been delayed in getting on-orbit, but the first launch of WGS-1 in October 2007, was successful, with two more launches planned for FY09.

Then: The Study, in the mid-term, advocated a mix of leased Satellite Communications, use of Defense Satellite Communications System reserve transponders, mobile ground control stations, and a universal modem using Demand Assigned Multiple Access.

Now: Some of these solutions were implemented but by far the biggest growth has been the use of lease commercial satellites. A large part of Satellite Communication used in Desert Storm was over leased commercial satellites. Mobile ground control stations (with some exceptions) have not been built and existing Defense Satellite Communications System mobile ground control stations have been deactivated.

Army Communications Satellite (Far-Term post-FY03)

The Department of Defense program for future communication satellites is called Transformational Satellite Communications System. The program is experiencing continued programmatic uncertainty due to the high cost required to develop and produce it.

Then: The Study advocated for Army to initiate development and deployment of Army-owned satellite(s)/transponder(s).

Now: No such satellites exist nor do any plans for Army procuring of such satellites exist.

Global Integrated Surveillance/Weapons System (Far-Term post-FY03):

U.S. Strategic Command is currently advocating the need for a fully integrated global Intelligence Surveillance and Reconnaissance capability and better integration/visibility of sensor data to/from weapon platforms. If these aspects are implemented in the next decades the Study vision will have been realized with the exception of Space-basing of weapons.

Then: The Study estimated that fielding Space-based capabilities to both conduct in Space target analysis as well as conduct combat operations from Space would be possible by 2005. The Study advocated for a fully integrated Space and terrestrial global surveillance and attack capability.

Now: Although specific systems composed of multiple components have achieved what the Study team envisioned on a limited basis, the full potential advocated remains to be put in place.

THEN AND NOW LEVEL 2 ITEMS:

Position/Navigation Systems:

Army Space Initiatives Study team clearly underestimated the profound impact of the Global Positioning System (GPS) in virtually every aspect of military, commercial and personal activities. Nor did they anticipate the interest in fielding of competing Space systems by the Russians, Chinese and Europeans.

Then: The Study advocated continued development such as the Position Location Reporting System-Joint Tactical Information Distribution Hybrid System. The GPS was recognized as the foundation with most applications directed towards artillery, aviation, and tactical location via communications systems such as Position Location Reporting System.

Now: GPS is everywhere throughout the force including in individual munitions such as artillery shells. The Army remains actively engaged in specifying ground force requirements for the next generation GPS satellites and user equipment and is currently fielding the Defense Advanced GPS Receiver (DAGR) and Ground-Based GPS Receiver Application Module that implements Selective Availability Anti-spoof Module technology, to replace the Precision Lightweight GPS Receiver and is working towards an enhanced, better protected, next generation of user equipment.

Electronic Countermeasures/Directed Energy Weapon Vulnerability/ Susceptibility Research:

Protection of Space capabilities is a major concern area for military and national intelligence communities, however, it remains poorly resourced and protection capabilities are rarely identified as one of a system's Key Performance parameters.

Then: The Study advocated increasing programs for research throughout the electro-magnetic spectrum to include Directed Energy Weapon effects.

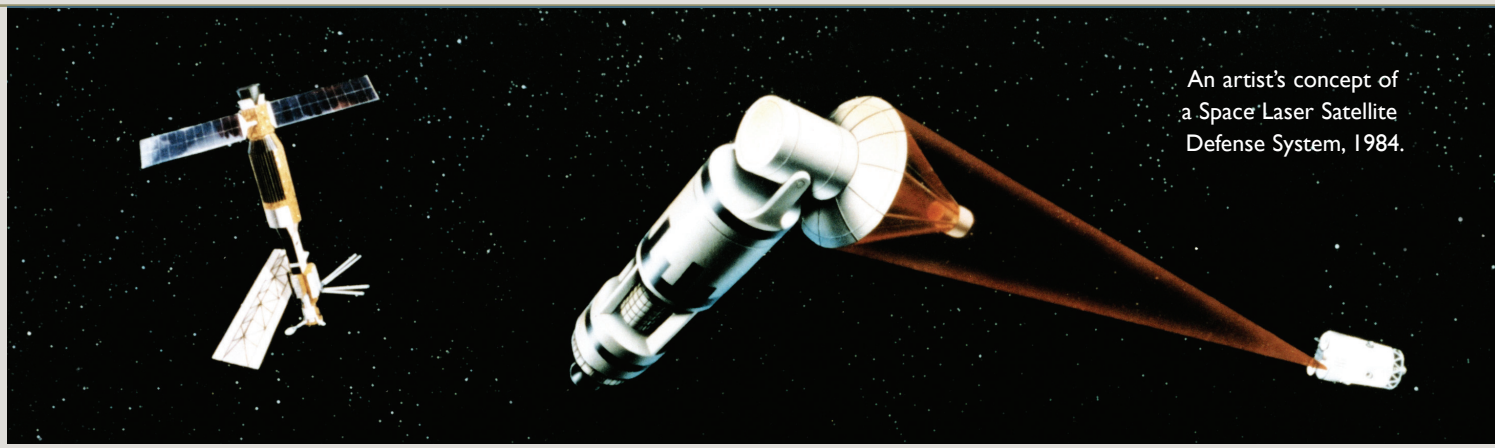
Now: Research has been expanded to include more than just tradition Radio Frequency Electronic Countermeasures but it not clear that vulnerability research for Space systems (with respect to Directed Energy Weapon) have kept pace with offensive capabilities.

Cheapsats:

Although standard buses exist, most satellites use unique buses with commonality limited to multiple payloads in a series. The reduced costs and standardization associated with volume production generally have not been implemented in the Space business.

Then: The Study advocated the development of a standard satellite bus (or family of buses) and a series of modest capability payload packages primarily associated with command, control communications and intelligence. The idea was to build payloads in quantity to reduce costs. The Study team also recommended funding to determine feasibility to use standard Army missiles – Pershing II as an example – for a launch capability.

Now: Both, government funded and commercial funded, organizations have developed standard buses. No Army launch capability was ever seriously examined.



An artist's concept of a Space Laser Satellite Defense System, 1984.

Tactical Exploitation of National Capabilities (TENCAP):

The TENCAP Program, started in the 1970s, provided modest Army resources to pick low hanging fruit from the strategic intelligence capabilities built up by National Reconnaissance Office and others. Details of specific activities remain classified.

Then: The Study advocated expanded funding for TENCAP. The Study team viewed TENCAP as tremendously successful and a program that should be expanded to additional tactical users.

Now: TENCAP success has continued and related capabilities have expanded from being only at Corps in 1985 down to Brigade or even lower echelons today.

Command and Control and Airborne Management System:

Existing techniques have relied on terrestrial and airborne command and control systems. The Space role has been limited to GPS and communication pipes which support operational command and control.

Then: The Study advocated a Space-based system which insures command and control down to the aircraft and Forward Support Air Defense Artillery weapons level.

Now: No such Space-based system was ever seriously proposed.

Nuclear Detection and Tracking System:

Nuclear detection devices on the tactical battlefield were probably never more than a neat idea, but the practical aspects of having the required intelligence and delivery capabilities to support their dissemination and operations was very unlikely.

Then: The Study advocated development and procurement of a tactical nuclear detection system based upon the Torso Vest technology. The idea was to use Remotely Piloted Vehicles to drop thousands of the devices across the tactical battlefield and use satellite communications for reporting.

Now: With the decline of the potential threat, this proposal was never acted upon.

Space Test Program:

A useful way to get small (and cheap) experiments a ride to Space. Army experiments found in record include BLAST (a laser communication experiment), high resolution photography for terrain analysis, a medical experiment to reduce the time necessary for blood clotting, and ground moisture monitoring for insect vector estimation.

Then: The Study advocated Army funding for worthwhile experiments submitted by Army Laboratories or other elements of the Research and Development community. Also considered were proposals from commercial sources and sponsorship of high school or college science projects. Flights would be arranged via the joint Space Test Program to fly on the shuttle or other Space flight opportunities.

Now: A number of experiments were funded including at least four on the shuttle including a specialist (terrain analyst) flying on the shuttle. The Space Test Program still operates and Space and Missile Defense Technical Center monitors its effort. The Army sits on the Space Experiments Review Board of the Program.

In 1994, the Extended Range Interceptor (ERINT) was selected as the interceptor for the Patriot Advanced Capability-3 (PAC-3). *U.S. Army Photo*

Medical Research and Development Program:

The Space Test Program provided resources along with Army Space Technology Research Office, the Intelligence Center and School and the Engineering Schools to actually conduct some experimental analyses to show insect vector estimation was feasible in the early 1990s. Additionally, the Army Space Technology Research Office and the Army Medical Command sponsored some experiments which were flown on the shuttle with respect to limiting blood flow or enhancing clotting for grievous wounds. It is unknown if the Army medical community has continued work in these areas but certainly similar medical experiments have flown in Space in the last few years.

Then: The Study advocated pursuing national imagery capabilities combined with terrain analysis and medical disease propagation models to better estimate areas at risk of insect disease outbreaks. Secondly they advocated a sensor designed to provide individual causality location and status information via satellite communications and thirdly, the examination of blood clotting in Space.

Now: Commercial sources provide data to allow this to be done to determine ground conditions favorable for insect vectors of disease. No individual casualty sensor was ever pursued. Blood clotting experiments were done as part of the Space Test Program effort.

NASA Advanced Communication Technology Satellite:

Description: The Advanced Communication Technology Satellite was a very successful demonstration and pathfinder for Army requirements and use of Ka wideband broadcast communications. The demonstrations turned "operational" when Army Space Command supported operations in Haiti. The satellite survived much longer than its original intended life of 2-4 years. It was finally shut down in the spring of 2004

Then: The Study advocated entering into a Memorandum of Understanding with NASA in 1993 to examine the technologies being developed and use NASA's channels for experimentation.

Now: Army Space Command through the Army Space Exploitation and Demonstration Program and in conjunction with U.S. Army Signal Center built a mobile broadcast ground station and demonstrated it during various Army and joint exercises and experiments. Eventually equipment was transferred to U.S. Army Southern Command for operational use (1997).

Advancement in GPS Technology
Above — Precision Lightweight GPS (PLGR)
Below — Defense Advanced GPS Receiver (DAGR)

U.S. Army

Space-Related Equipment Training and Demonstrations:

The AN/TSC-85 and 93 terminals were pulled out of echelons Corps and below and fielded to the Expeditionary Signal Battalions along with the Phoenix quad band terminal. Echelons Corps and Below now have numerous SATCOM terminals; from Secure Mobile Anti-Jam Reliable Tactical Terminal's (down to Brigade); Joint Network Node Veridian Status Accounting Tracking Systems (down to Battalion); Trojan Spirits (down to Brigade); Combat Service Support Veridian Status Accounting Tracking Systems (down to Battalion); Global Broadcast Service (down to Battalion) and so on. Many other commercial SATCOM systems have been procured via unit Operational Needs Statements in support of Operations Iraqi and Enduring Freedom.

Then: The Study advocated buying Space-related equipment and evaluating it in experiments and exercises. Identified opportunities were focused on Air Defense utility and included AN/TSC-93 Satellite Communication terminal for tactical communications; commercial GPS terminals; use Space Test Program to evaluate Air Defense Artillery vulnerabilities.

Now: Air Defense Brigades were equipped with AN/TSC-85/93s by Desert Storm; GPS terminals were not fielded to Air Defense units until the Small Lightweight GPS Receiver and then Precision Lightweight GPS Receiver became available.

Integrated Closed-Loop Intelligence/Target Acquired System (Mid-term FY93-FY03):

A global sensor vision and various service programs to make "every sensor a shooter and every shooter a sensor." It is still under works to implement the basic concept of integrated intelligence and fire unit command and control.

Then: The Study advocated using satellite communications to enable the merger of intelligence, surveillance and reconnaissance and "shooter" command and control to allow all system to interact.

Now: A dream still being worked.

Automatic Target ID System (Mid-term FY93-FY03):

Automatic Identification techniques have provided insight but brute force computation capabilities have improved so rapidly as well as change detection techniques that the system as such has not been a big player.

Then: The Study advocated funding for hardware and software efforts to achieve near-real-time automatic target recognition. The software portion focused on Automatic Identification efforts. The hardware portion focused on the "Fourier Camera" work of Jet Propulsion Laboratory, but it was never funded by the Army.

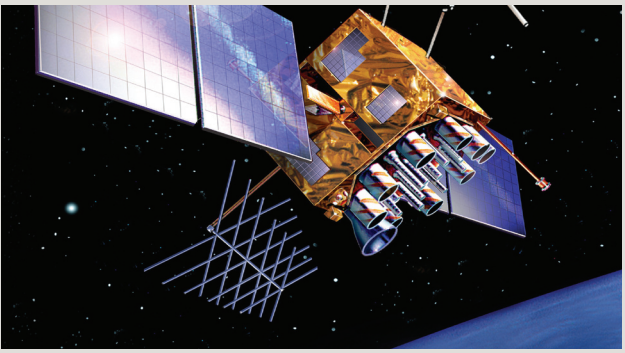
Now: Neither effort ever led to an operational capability.

Smart Sensors (Mid-term FY93-FY03):

Smart sensors continue to be an area of pursuit including the ability of sensor systems to manage them. This includes self-organizing mesh networks and sleep modes to save power.

Then: The Study advocated efforts to produce self-managing sensor systems to move sensor analysis and management to the tactical sensor itself to reduce communication loads going to the rear.

Now: Although not done with Automatic Identification, many of the techniques currently in use greatly reduce quantity of data that must be transmitted to rear areas.



Artist rendition of a GPS Satellite

Automatic Multi-sensor Integration (Mid-term FY93-FY03):

But one more aspect of the Global Sensor Vision of integrated intelligence, surveillance and reconnaissance articulated recently by U.S. Strategic Command. Reluctance remains in the intelligence community about the use of the term correlated intelligence when speaking of fused sensor info … but the technology is moving that way.

Then: The Study advocated a development effort to allow diverse sensors on one platform to integrate their observations to provide a correlated intelligence product.

Now: This has been achieved to some extent with EOIR sensor suites and further work continues with other sensor combinations.

Space support to the warfighter

U.S. Army Photos

Commercial Reserve Communications Satellite Program (Mid-term FY93-FY03):

Desert Storm illustrated the point that the capability to rapidly obtain use of commercial Satellite Communications required funding and contracts in place well before the need arises. Even so, the Department of Defense has not invested in a program of regular leasing of commercial Satellite Communications and the continued rapid growth of information exchange requirements means military use of Satellite Communication is likely to always strain existing capacity when major operations take place.

Then: The Study advocated funding a program similar to the one used to obtain U.S. owned aircraft and merchant ships in a time of national emergency and the funding to exercise it at least once a year.

Now: A viable means of establishing the equivalent of a Civil Reserve Air Fleet program for commercial Satellite Communication has never been identified.

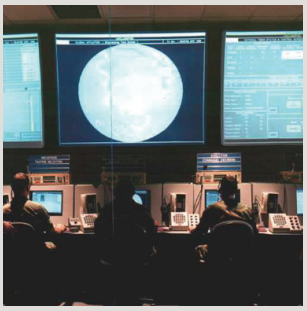
Space-Base Processing Centers (Mid-term FY93-FY03):

We still have not figured out how to do it on earth – much less with the complications of putting into Space. Not likely before the end of the Study period.

Then: The Study advocated using super computers in Space to provide what we now call the Common Operating Picture and then tailor that to the needs of individual commanders.

Now: No plans to put such a capability in Space.

Situational Awareness



U.S. Army Photos

Kinetic Energy Weapons (Mid-term FY93-FY03):

Electromagnetic guns are another perennial "almost there" technology. It promises better range and penetration energies but practical aspects of fielding have so far prevented any operational use.

Then: The Study advocated closely monitoring development of electromagnetic guns. The belief was that such a gun could be Space-based.

Now: Such technology has never progressed to an operational system.

Unmanned Aerial Vehicle Hunter-Killer (Mid-term FY93-FY03):

Robotics has not advanced as quickly as the Study envisioned. In larger part this is true because Artificial Intelligence or AI like programming has not progressed to allow operational autonomous operations except in much defined circumstances.

Then: The Study advocated the development of autonomous Unmanned Aerial Vehicle reconnaissance and killers working in concert.

Now: No such systems exist, although the technology exists to field such systems for use in limited scenarios.

Military Aerospace Vehicle (Mid-term FY93-FY03):

Marines have an approved operational need statement for a similar capability using Space launch.

Then: The Study advocated defining Army requirements for hypersonic transports to move supplies, personnel and equipment.

Now: No Army requirement has ever been approved.

Decision Aids (Mid-term FY93-FY03):

Communications and sensor integration capabilities are not yet in place to support this. The Study was a little premature on this, but it is certainly conceivable in the next decade or so. Given the ubiquity of unmanned vehicles (particularly aircraft), this idea continues to have merit. Given the explosive growth in commercial automobile and various internet mapping programming, it is likely this capability will be routinely available in the next decade.

Then: The Study advocated development of a system to combine airborne and satellite imagery to provide near-real-time maps.

Now: Digital Topographic Support System and various commercial systems can produce maps using such data sources but it is not near-real-time.

Cooperative Autonomous System (Far-term post FY03):

Given that the Study goes out to 2025 this is not an unreasonable expectation. Confidence in autonomous combat operations will have to be obtained for this to be politically viable no matter what technology exists.

Then: This extends the Unmanned Aerial Vehicles Hunter-Killer concept previously mentioned to include ground combat vehicles

Now: Active research underway to make this feasible.

Satellite Communications Terminal Technology (Far-term post FY03):

Has a potential advantage in throughput, multi-channel and better survivability.

Then: The Study advocated continued technology development to exploit Extremely High Frequency advantages for all combat forces.

Now: Such work continues at Communications-Electronics Research Development and Engineering Center and may be incorporated into the Army's next-generation tactical Satellite Communication terminal program, the High Capacity Communications Capability terminal.

THEN AND NOW LEVEL 3 ITEMS:

Air Defense Multiple Sensor Integration Systems:

Air Defense has worked issue with out Space as part of the sensor set with the exception of Ballistic Missile Defense which includes Digital Signal Processing. At various times, special Space sensors have been proposed but none funded to the point of being developed.

Then: The Study advocated an Air Defense system that would be capable of integrating ground, air, and Space sensors to provide correlated target data.

Now: No Space sensor dedicated to Air Defense exists nor are any programmed.

Light-weight Composite Materials:

Detectors may be linked with Satellite Communication but there is no specific program to field such a CB capability.

Then: Army Space Initiatives Study advocated development of miniature CB sensors using Satellite Communication to report their results.

Now: Lots of work in miniature detectors.

Improved Reserve/National Guard Training:

This was included in Study because the Study team believed dedicated circuits owned by the Army would be required. Also they assessed at the time that such distribution via "private broadcast networks" over Satellite Communications would be the most efficacious and cost effective means available.

Then: The Study advocated leasing Satellite Communications to provide television and other capabilities to aid in Reserve/National Guard training.

Now: To the extent that is applicable distance learning using Video teleconference and Internet protocol-based, browser-enabled tools which were not envisioned by the Study. To some extent these capabilities use leased circuits provided by Defense Information Systems Agency

Super High Frequency Improvements:

Not strictly a Space issue. It was included because improved materials for antennae, especially ones which would permit weight reduction (such as graphite fiber), would facilitate use of Satellite Communications at lower, more tactical echelons of the Army.

Then: The Study advocated improving Super High Frequency antenna by reducing its weight using graphite fiber technology.

Now: Evolution of materials technology has permitted development using a broad range of carbon composites.

Satellite Communications

U.S. Army Photos

Alternate Means of Communications:

The Army Space Exploitation and Demonstration Program experimented with laser to Space shuttle communications with limited success. This is not strictly a Space issue but the vacuum of Space provides the best environment to utilize laser communications.

Then: The Study advocated pursuing research in Multi-Megawatt, meteor burst, and laser communications.

Now: Research proceeds on all three and some capability exists in Multi-Megawatt and meteor burst.

Equipment Monitoring and Reporting System (Mid-term FY93-FY03):

Not strictly a Space issue – Army Space Initiatives Study was grasping when they included this.

Then: The Study advocated developing a self-diagnostic monitor on each critical move, shoot, and communicate system which isolates and records the source of system failure and report same via Satellite Communications to appropriate units.

Now: Diagnostics have progressed but there is no specific system to feed the information via Satellite Communications.

Multi-spectral Orbital Sensor Constellation (Mid-term FY93-FY03):

At the time of Army Space Initiatives Study, the U.S. Air Force and Navy had competing designs. Competition eventually killed both efforts. WARFIGHTER, Tactical Satellite, and Operationally Responsive efforts to fly tactical support radar or other multi-spectral sensors continued since Army Space Initiatives Study up to the present time. Space and Missile Defense Command (Future Warfare Center) continues to work closely with the IC to successfully initiate development of these satellites.

Then: Army Space Initiatives Study advocated Army participation in a joint program to put in place Space-Based Radar and/or a Space-Based Infrared system of four satellites.

Now: Army requirement were articulated and interest is high. Space and Missile Defense Command Future Warfare Center has worked extensively with Army exercise community to evaluate the potential value of such systems and to help refine Army requirements.

Army Anti-satellite (Mid-term FY93-FY03):

There has been strong resistance due to U.S. and international concerns/politics pertaining to the "weaponization of Space" concerns about unnecessarily creating excessive debris in earth orbital Space, and no firm decision or requirement currently exists to field such a system. The recent Chinese anti-satellite weapon test and the U.S. shoot down of a U.S. failed satellite (to prevent potential ground effects) have provided much more data to evaluate the debris concern.

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from page 43

Then: The Study advocated Army program to develop a kinetic-energy anti-satellite by combining Miniature Homing Vehicle with the Army Pershing II.

Now: Joint Program started but unfunded in early 1990s

Space-Based Munitions Guidance (Mid-term FY93-FY03):

Many conventional munitions (including hundreds of thousands of artillery shells) can be retrofitted with GPS guidance.

Then: The Study advocated used of Space systems to provide laser designation of targets and second to incorporate GPS into munitions.

Now: Laser designation from Space never happened. GPS has been incorporated into many munitions.

Autonomous Collection System (Mid-term FY93-FY03):

Description: Like other Artificial Intelligence related ideas the Study was premature in estimating when this technology would be available.

Then: The Study advocated development of autonomous control and collection systems for intelligence, surveillance and reconnaissance sensors on unmanned aerial vehicles and Space systems.

Now: No capability currently exists

Space Station (Mid-term FY93-FY03):

Station was de-militarized and in any case the resources vice benefit equation did not excite Army leadership. Instead for a time there was a military component to the International Space Station and through the Terra Scout program the Army Intelligence community investigated potential for human observation from Space.

Then: The Study advocated Army resources (people and funds) be used to develop a Space-based technical control facility for Space communications.

Now: Never happened.

Atmospheric Monitoring System (Mid-term FY93-FY03):

Budget limitations have precluded such an operational sensor flying so far. Much of the data it would collect can be obtained with sensors that consume far less power.

Then: The Study advocated the development of Space Doppler radar to sample winds and other meteorological data over the battlefield.

Now: Never happened. Army did support requirement for such a sensor on National Oceanic and Atmospheric Association/U.S. Air Force polar orbiting satellites.

Power Generation & Transmission System (Far-term post FY03):

Cost versus benefit trade-off has never supported Space-based system. Space and Missile Defense Command continues to forecast military utility to the U.S. Army if technology becomes available making the Space segment cheaper. Some forecasts indicate feasibility by 2025. (Opinion — until Space lift cost per pound is significantly reduced, this will not be economically feasible. A further consideration has to be the popular myth that overhead power lines and cell phones cause cancer – that protest will be nothing to outcry against Space systems beaming radiation at the earth.)

Then: The Study advocated the research and development of Space power stations converting sunlight into micro-wave energy which could be transmitted to ground receivers.

Now: Never resourced by anyone other than some very preliminary basic research.

Tactical Weather Support System (Far-term post FY03):

Energy budget does not make sense. Politics is unlikely to support weather modification much less weather modification from Space.

Then: The Study advocated using Space-based platform to modify the weather by using directed energy.

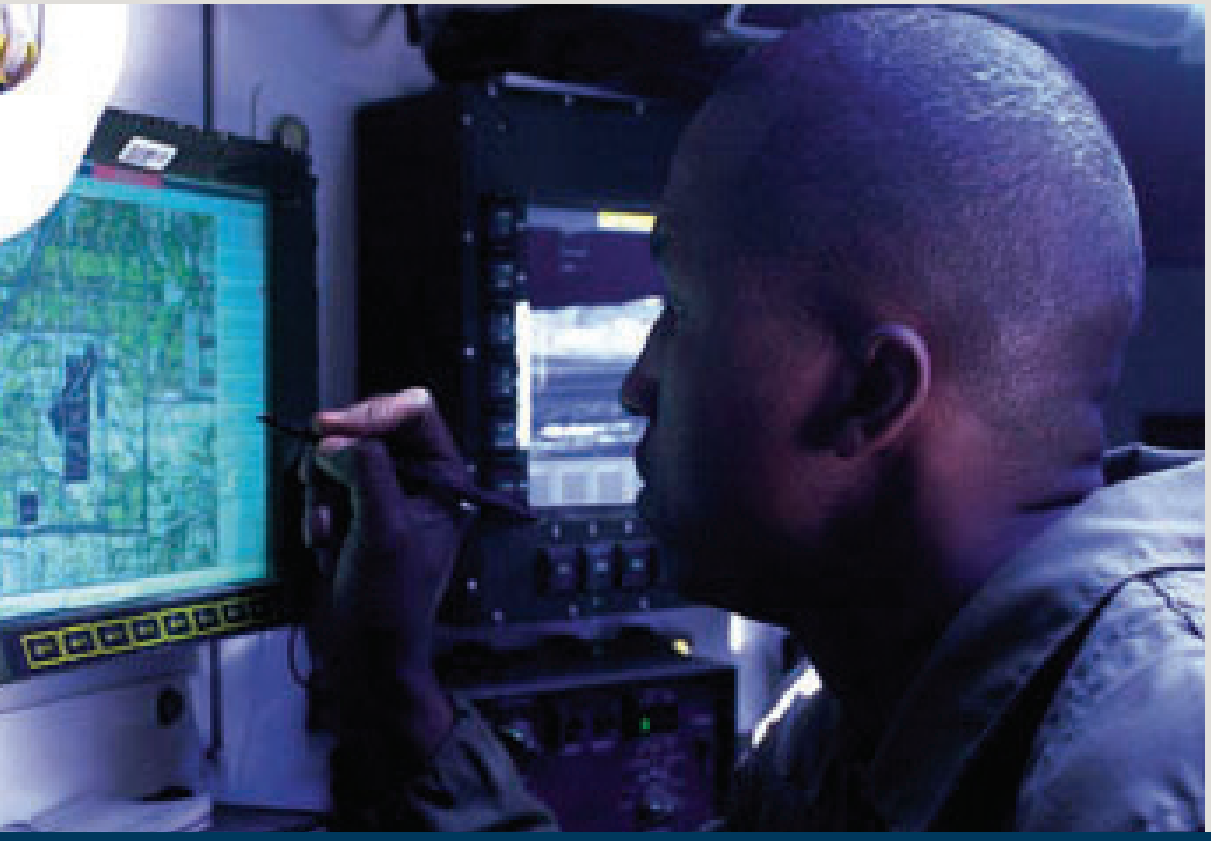
Now: Never happened.

Advance Technology Weapons (Far-term post FY03):

Too undefined to survive budget/requirement reviews.

Then: The Study advocated for funding to support advanced concept development as technological advances in aerospace developed.

Now: Never happened.



Tracking: SFC Kenneth Dawson of Fort Lewis, Wash., checks the map of his Force XXI Battle Command Brigade and Below (FBCB2) system, a widely used but limited blue force tracking system that is being improved.

U.S. Army photo by CPT Timothy Beninato