STRATEGY RESEARCH PROJECT

THE ROAD TO INFORMATION DOMINANCE: "SYSTEM OF SYSTEMS" CONCEPT FOR THE UNITED STATES ARMED FORCES

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ABSTRACT

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Information and technical superiority is the foundation on which our National Military Strategy implementation rests. The advancement of technology transformed warfare into the art of employing integrated advanced information and weapons systems with forces to dominate an opponent strategically, operationally and tactically. The dominance exhibited by U.S. forces in Operation Desert Storm demonstrates reliance on advanced technology to "win" decisively. Maintaining a technological edge grows increasingly important as force structure decreases and high-tech smart, expert and possibly brilliant weapons become readily available on the open market. Our current technological advantage is based on past experience with an investment in technology. It is prudent and reasonable to assume that our future warfighting capabilities will be appreciably forged by today's contribution. This study focuses on information dominance through the U.S. Armed Forces "System of Systems" concept. It addresses and analyzes current and future strategic implications and requirements for U.S. warfighting communications and information systems. It proposes a more flexible, reliable, responsive, robust and survivable high capacity throughput communications and "bitways" system to support future force projection operations for the Force and/or Army After Next. Lastly, it concludes with a suggested methodology to implement the "System of Systems" concept to enable information dominance.

TABLE OF CONTENTS

PREFACE

The Joint Staff, the military acquisition community, corporate America, the U.S. Army Signal Center and the service's battle labs are but several of the major players in determining 'how' the U.S. armed forces will pave the road to information superiority. They are the mainstream developers and implementers of the *Joint Warfighting Science and Technology Plan* and the Department of Defense (DoD) *Information Technology Management Strategic Plan Supporting National Defense*. This community supports the Chairman of the Joint Chiefs of Staff's *Joint Vision 2010* (JV 2010).

These plans, plus the plans of the military services and defense agencies, provide input into the DoD budget and service program objective memorandums (POMs). Our government, military, defense industry and allies share the common goal of maintaining superior warfighting capabilities and improving interoperability between the U.S. and its allies. The intent of this study is to promote creative and critical thought on implementing the U.S. Armed Forces "System of Systems" concept paving the way to information dominance. Its goal is to assist in the requirements determination and development process for communications and information systems to support the above plans and future POMs.

LIST OF ILLUSTRATIONS

LIST OF TABLES

THE ROAD TO INFORMATION DOMINANCE: "SYSTEM OF SYSTEMS" CONCEPT FOR THE UNITED STATES ARMED FORCES

INTRODUCTION AND BACKGROUND

This study examines National Military Strategy in the area of information dominance through the "System of Systems" concept of the United States (U.S.) armed forces. It provides a description of the current U.S. National Security and Military Strategies on information dominance and focuses on the military's "System of Systems" concept towards achieving information dominance. It addresses and analyzes current and future strategic implications and requirements for U.S. warfighting communications and information systems. It proposes a more flexible, reliable, responsive, robust and survivable high capacity throughput communications and "bitways" system to support future force projection operations for the Force and/or Army After Next. Lastly, it concludes with suggestions for a methodology to implement the "System of Systems" concept to support information dominance.

This section provides the foundation for which all concepts and ideas used within this study are based. It provides a U.S.

strategic perspective for information dominance and a brief analysis of and courses of action for the "System of Systems" concept. It will uncover significant challenges and risks that must be accepted or reduced in order to achieve the ends and plausible courses of action to implement the "Systems of Systems" concept towards achieving information dominance. Lastly, it provides a recommendation to best employ strategic resources, capitalize on information technology and improve "Systems of Systems" reliability and security.

National Security, Defense and Joint Strategies

The National Security Strategy's core objectives are: to enhance national security with effective diplomacy and with military forces that are ready to fight and win; to bolster America's economic prosperity; and to promote democracy abroad.[1] America's core values are embraced by many nations around the world which, in turn, foster global cooperation and stability. America's global interests means the U.S. is faced with the challenge of maintaining superior technological and military capabilities.[2] Inherent to this challenge is the requirement to maintain superiority in information technology, both in capitalizing on its power and protecting it from tampering and exploitation. This rational is implicit in the Quadrennial Defense Review (QDR) and National Military Strategy: that the U.S. must exploit technological advances that are changing the nature of warfare.[3]

The current defense strategy seeks to shape the strategic environment to advance U.S. interests, maintain the capability to respond to the full spectrum of threats and prepare now for future threats and uncertainty.[4] To implement this strategy, emphasis is on investing in modernization to exploit current and future information technologies. Exploiting information technologies combined with integrating other new technologies is expected to provide capabilities that give the U.S. a decisive advantage.

The *Joint Vision 2010* (JV 2010) conceptual framework for new U.S. military operational concepts embraces information superiority as "enabling" the vision of "full spectrum dominance."[5] Information superiority is the ability to collect, process and disseminate an uninterrupted flow of information while exploiting or denying an advisory's ability to do the same.[6] The four JV 2010 operational concepts are dependent on information technological advances and superiority: *Dominant Maneuver* requires a full picture of the battlefield in depth;

Precision Engagement requires near real-time information and a common awareness of the battlespace for command and control, and target identification and engagement; *Full-Dimensional Protection* requires information superiority of U.S. forces to maintain freedom of action; and *Focused Logistics* depends on information technology to ensure accuracy and enhance movement, storage and delivery systems.[7] *JV 2010* is illustrated in figures 1 and 2.[8] The desired vision requires the U.S. to strive for information dominance.

The road to information dominance is through a "System of Systems" of integrated smart, expert and brilliant communications, computers, software, sensors and weapons systems creating synergy between battle space awareness, enhanced command and control, and precision force. Across the "System of Systems" travel bit-streams of information supporting a wide variety of users (commanders/planners, administrators/logisticians and leaders/soldiers/civilians of the U.S. and its allies). Ultimately, this capability will increase effectiveness and efficiency across all spectrums of operations during peacetime and war. This advanced technological capability theoretically enables the U.S. military to lead its competitors in the conduct of parallel and stand-off warfare with high precision against targets over the entire battlespace of its adversary as well as providing complete situational awareness in the conduct of peacetime engagements.[9]

Analysis

An analysis of the ENDS-WAYS-MEANS of the "System of Systems" concept concludes the ENDS (a "Systems of Systems" providing information dominance) is a viable vision to strive for but significant challenges and risks must be accepted or reduced in order to achieve it. The strength of the ENDS, discussed above, is the U.S. military will increase effectiveness and efficiency across all spectrums of operations during peacetime and war and the ENDS provide capabilities that give the U.S. a decisive advantage. The weaknesses are that the WAYS [command, control, communications, computers and intelligence (C4I), sensor-to-shooter, target acquisition and situational awareness systems] are not integrated but are end-to-end or often 'stovepiped' systems and the MEANS (data transmission systems) are extremely vulnerable, inflexible and lack robustness.[10]

During the Gulf War with Iraq, the ENDS - "Systems of Systems" concept - was derived through the use and reliance on advanced information technologies to defeat a force presumed to be an adversary equipped with at least modern or current technology. Even with the great successes of the WAYS - C4I, sensor, long-range fires and air-sea-ground precision guided munitions, targeting and missile defense systems - it was recognized the ENDS - "System of Systems" - must be more timely, reliable, flexible, portable, mobile and hardened. Further, in the future, the WAYS (stovepiped systems) require more MEANS - national or military geocentric/stationary satellites or systems of air/ground deliverable lower altitude (disposable, recoverable or reusable) satellite systems - or data pipelines with the capacity to transport much larger volumes of data.[11]

A major liability of the WAYS and MEANS is that current military systems rely heavily on commercial information and networking infrastructures. Everyone has access to the same technology on the open market. Military systems' security is susceptible to physical, electronic, and software (hacker or 'cyber' intrusion) disruption in rear areas (continental U.S.) because the civilian information and networking infrastructure is extremely vulnerable.[12] The current civilian infrastructure of WAYS -- networks and information systems -- and MEANS -- bit stream pipelines and satellite systems -- are put at risk due to poor physical and software security. This risk is so serious that the President's Commission on Critical Infrastructure Protection lists Information and Communications at the top of its list of critical infrastructures to protect from physical and cyber threats.[13] Networks and computer system technology are merging at such an extremely fast rate and are so interdependent, that both are susceptible to disruption and/or destruction when either is physically, electronically or cyber intrusion attacked. Current transmission media, terrestrial or space based satellite systems face the same risks.

Courses of Action

Courses of action to ensure the U.S. National Security and Military Strategy objectives for information dominance are achieved through the "System of Systems" concept must focus on: the integration of information technology; increased data or bit-stream capacity and transmission flexibility; and physical, electronic and cyber intrusion security.

The first course of action is continued development of end-to-end systems with the integration of information operations handled by "gateway" or "bridge" computer systems. This equates to the current technique of 'black-box' technology. This approach requires development of an interface standard for each and every information operations integration task. For example, message processing, force planning and data transmission systems would require black-box technology to allow users to simultaneously access and share information on force planning and messages development in relatively near-real-time. This course of action would also require more terrestrial and space-based satellite systems to handle the vast array of stovepiped systems and data. National commercial standards for physical, electronic and cyber intrusion security must be implemented to maintain assured "System of Systems" security.

A second course of action is to shift the paradigm from end-to-end stovepiped systems to a complete merger of telecommunications and computing technology.[14] The new information operations technology paradigm would use standard data or "bitway" networks and Internet Protocols (IPs) allowing for a host of diverse media (digital voice, video and data, and fiber-optics, etc.) overlaid with applications to perform the traditional user or weapon system information manipulation and presentation (see figure 3).[15] Users' and/or weapons systems' access to information would be on a need-to-know relationship rather than physically accessing a multitude of stovepiped systems. Thus, the current terrestrial and space based satellite transmission systems would be more efficiently used. Therefore, less satellites would have to be added to the current satellite constellation than the first course of action. [Reference the 1997 Army Satellite Communications (SATCOM) Architecture Book for current and planned national defense satellite communications systems.] National commercial standards for physical, electronic and cyber intrusion security are still required for assured "System of Systems" security.

A third course of action implements the new information operations technology paradigm above with an even smaller number of additional national or military geocentric/stationary satellites. A system of air/ground deliverable high altitude extended endurance (HAE)(disposable, recoverable or reusable) Unmanned Aerial Vehicle (UAV)/surrogate satellite systems could provide a "large volume digital C4I umbrella" over a deployed military force.[16] This C4I "umbrella" would provide capacity to transport large volumes of digital information supplementing and lowering reliance on the nation's strategic satellite system before, during and after force deployment (figure 4). A system or formation of networked UAVs could provide smart, expert and brilliant communications, for digital voice and/or data tactical-to-strategic, computer-to-computer, sensor-to-weapon and weapon-to-weapon systems. This approach creates synergy between battlespace awareness, enhanced command and control, and precision force. Today's High-Capacity UAV (Predator) is a step towards this concept.[17] Even closer to this concept are the emerging HAE UAVs Global Hawk and Dark Star.[18] The deployed force would be less dependent on the civilian information and networking infrastructure providing more physical, electronic and intrusion "System of Systems" security.

Recommended Approach

The third course of action provides the most cost effective and advantageous position to achieve information dominance through the "System of Systems" concept embraced by U.S. National Military Strategy. JV 2010's "Emerging Joint Strategy for Information Superiority" provides the framework to capitalize on current and future information technologies supporting the operational concepts of *Full Spectrum Dominance*.[19] This course of action falls well within the domain of JV 2010.

Emerging U.S. military systems are taking advantage of the telecommunications and computing technology merger [i.e., the Defense Message System, the Global Command and Control System, and the C4I For The Warrior System combined with Asynchronous Transfer Mode (ATM) Technology]. This approach increases the efficiency of large "bitways" across the current national strategic satellite system. Advanced UAV C4I payload technology will provide U.S. military forces increased flexibility of maneuver, engagement, logistics support and protection by providing a "large volume digital C4I umbrella" before, during and after deployment. Overall, this effort enhances efficient use of national strategic satellite resources and lowers reliance on the current civilian information and networking infrastructure to maximize "System of Systems" security until effective and assured system security matures.

The final recommendation is to integrate the above "System of Systems" concept into the National Defense Strategy to ensure progress towards information dominance. This strategy is a cost effective design that bests employs the Nation's scarce strategic satellite systems, capitalizes on the power of information technology and improves "Systems of Systems" security. It permits the U.S. military to exploit and integrate information technologies with other new technologies to implement capabilities that give the U.S. a decisive advantage.

The remainder of this study will investigate the current and future "bitway" networks, HAE UAV technology, and the blending of each to support the C4I requirements of the Force and/or Army After Next. It will describe a more flexible, reliable, responsive, robust and survivable high capacity throughput communications and "bitways" system to support future force projection operations. Finally, it will conclude with suggestions for a methodology to implement the "System of Systems" concept to support information dominance.

BITWAY NETWORKS

Background

As mentioned earlier, the technologies of computing and telecommunications are merging at an extremely fast rate.[20] The U.S. military has made great strides in warfighting capabilities by capitalizing on computing and communications. The development and fielding of sensor-to-shooter systems; smart, expert and brilliant weapons systems; and advanced warfighting and computer information systems (such as video teleconferencing; Defense Message System; Global Command and Control System; C4I For The

Warrior; digital logistics systems; Maneuver Control System; Trojan Spirit and other intelligence distribution and collection systems; Airborne Early Warning Systems; etc.) are earnest attempts to capitalize on the power of information technology but fall short of fully realizing the merger of communication networks and computerization.

Impact

This convergence will have a profound impact on U.S. and international information technology. The traditional (and still active today) course of action where stovepiped information systems and computers send and receive data to-and-from other like systems through specifically designed communication means or networks will reach a culmination point in the near future. Users want network 'transparency.' They do not want to deal with multiple "bitway" providers and they want integrated network services. Future computer information systems must be designed to communicate asynchronously with any and all other systems via a common communications "bitways" system. Encryption and standard data routers and headers will ensure delivery of information to the right address and to an authorized user or computer system. In other words, the traditional definitions of telecommunications (communications over distance) and computers (programmable electronic devices that store, retrieve and process data) have become seriously blurred.[21]

Further, the commercial communications network information infrastructure -- the Internet and Asynchronous Transfer Mode (ATM) switching combined with advanced software languages and architectures [web-browsers, Hyper Text Markup Language (HTML) and Java computing] and personal computers integrated with continuous medium (audio and video) and blended applications -- provides a multimedia environment in which data and information are virtually available in any form to the user or another computer system that requires it. The QDR, JV 2010 (and the service visions of the future: for example *Army Vision 2010*) are advocates of the information technologies inherent in the "Revolution in Military and Business Affairs."[22] All embody the conceptual framework for new operational concepts embracing information superiority as the foundation for "full spectrum dominance."[23] However, even though we recognize this merger the civilian and corporate world, the U.S. military and defense industry have not taken full advantage of this technological shift. Stovepiped or unique computer systems and 'black-boxes' dominate both the civilian and military communications and computer information systems. Granted, both are taking advantage of the Internet. However, user applications, network applications, services and communication "bitways" still require substantial integration to achieve information dominance.

Requirements

The paradigm shift from end-to-end stovepiped systems to a complete merger of telecommunications and computing technology must take place in order to make substantial headway towards achieving information dominance. The emerging three-level horizontal architecture of applications, services, and "bitways" provide four categories of networked applications based on functionality and user temporal relationship with another user or server (see table 1).[24] This architecture (figure 5) can be built upon ATM and IPs with network and user applications overlaid to provide a seamless information network.[25] ATM provides a very high speed transmission technology for voice, data, video and television, maximizes network capacity and is compatible with wireless and satellite communications.[26] In order to provide assured information superiority and efficient and effective bandwidth use of current and future terrestrial, UAV and space based satellite transmission systems, U.S. military and civilian computer information systems and networks must be developed using this methodology. All future applications must be networked to take advantage of this powerful information systems architecture. In the future, networked applications will combine user-to-user and user-to-information (weapons/sensor/management) system-server functions in a mixed peer-to-peer or client-server architecture.[27]

Application

Recently, the U.S. Army Signal Center and Fort Gordon, Georgia, implemented a communications infrastructure using ATM as the single broadband telecommunications solution to provide media suited for multimedia interactive computer systems, video and high speed data transmission.[28] This effort resulted in an integrated high performance backbone ATM based network (figure 6).[29] Implementing ATM networks will solve time delays essential for quality high speed digital voice, data, signaling, Integrated Services Digital Network (ISDN) and interactive video conferencing.[30] Miniaturization of technology continues to produce larger capacity micro- and nano- computer chips. It is entirely possible, that an investment in today's larger ATM cell-multiplexers/concentrators (such as produced by LTI DATACOMM[31]) will lead the next generation of ATM: 'beyond-ATM.' This would provide multiple communications ports exceeding 200Mbps transmission speed over encrypted satellite, line-of-sight, wire-line, fiber-optic, and/or wireless medium in an extremely small package.

UNMANNED AERIAL VEHICLES (UAVS)

Overview

Today a variety of UAVs exist. Payload weight carrying capability, accommodations (volume, environment), mission profile (altitude, range, duration) and command, control and data acquisition capabilities vary significantly.[32] Routine civilian and military use of these various UAV assets for intelligence, surveillance, measurements/experiments and communications is emerging into a rapid growth market.

Numerous UAV configurations designed by the U.S. Department of Defense (DoD) have been developed since the late 1980s. The DoD promoted UAVs to fulfill mission unique surveillance requirements at various range categories: close range - 50 km; short range - up to 200 km; and endurance as anything beyond

200km .[33] The current classes or combination of these type vehicles are labeled as tactical UAVs, followed by endurance categories (civilian UAV categories are: local, regional and endurance.)[34] The current UAV categories are illustrated in table 2.

Approximately twenty-two companies within the U.S. are involved in the development of the approximately forty-five different UAV configurations (see table 3).[35] A list of current UAV performance and payload capabilities is presented in the UAV characteristics database at chart 4.[36] They range in size from hand-held to runway-based with payload weight capabilities ranging from a few pounds to over 2000 pounds. This comparison of various UAV endurance, payload weight, and altitude capabilities is illustrated to demonstrate the vast interest in and potential (civilian and military) use of future UAV technology.

Military UAV Requirements

Medium Altitude Long-Endurance (MAE) UAV support for the joint force was contracted in January 1994 and the first aircraft was flying six months later in July 1994.[37] The Predator UAV has supported numerous joint exercises and contingency operations since that time. It was designed to fly over designated areas and transmit imagery in real-time video and near-real-time still-frames. In July 1995, Predators deployed to Europe in support of contingency operations in Bosnia. During that time, over-the-horizon control of UAVs was demonstrated under combat conditions.[38] Despite the loss of two Predators in August 1995, the system proved its military utility.[39] The communications package onboard the Predator was line-of-sight radio followed by beyond-line-of-sight (Ku-band) SATCOM data transmission hardware.[40]

The JCS responsibility for validating UAV operational requirements belongs to the Joint Requirements Oversight Council (JROC) UAV Special Study Group (SSG) and the U.S. Air Force is designated as the lead service for HAE UAVs.[41] A series of program actions and rapid advancements in Predator UAV technology laid the foundation for the development of newer suites of HAE UAVs (such as the Global Hawk and the Darkstar).[42] Appendix B provides the information on these UAVs from the U.S. Air Force Battlelab.[43] The information in table 5a and 5b is a comparison of the characteristics of military UAVs.[44] As technology continues to exponentially grow, it is foreseeable that 'beyond-UAV' technology will provide powerful C4I capabilities.

Airborne Communications Node (ACN) Operational Concept

Currently the US Army Signal Center Directorate of Combat Developments, Concepts Branch, is developing a concept of operations for an Airborne Communications Node (ACN)(see appendix C).[45] The current ACN operational concept uses an HAE UAV to support the Joint Task Force (JTF), corps, and division battle command during strategic, operational and tactical level operations.[46] The ACN concept addresses Army and joint force mission needs but is designed primarily to support Army corps and division commanders fulfilling duties as a JTF and/or Army Forces (ARFOR) commander.[47]

The ACN concept provides limited but critical C4I support for the force commander where units and elements of the force are fighting on non-traditional non-linear battlefields and separated and dispersed throughout an area of operations. The ACN is designed to provide range extension (relay and connectivity) capabilities not possible with today's current suite of communications systems.[48] The ACN will provide aerial line-of-sight links for terrestrial systems, provide a large communications footprint for Combat Net Radio (CNR) retransmission systems and extend line of sight planning ranges.[49] Because future forces will operate as a joint and combined force, communications integration of such forces (some with state-of-the-art communications equipment and others with several generations of older systems) continues to be extremely difficult.[50] The ACN will enable U.S. service, joint and special operations forces and combined units to communicate with diverse radio systems using onboard gateways, bridges and relays (black-box technology).[51] The ACN is expected to reduce or eliminate joint and combined communications difficulties during critical phases of an operation and provide advanced communications services to the warfighter.[52]

Concept Advantages

The advantages of the ACN are applicable to the Force and/or Army After Next. The ACN supports joint/combined force projection operations with the capability to self-deploy anywhere in the world at anytime.[53] The ACN will reduce the need to airlift critical communications personnel and equipment for pre-hostility, enroute, and entry phases of an operation.[54] The ACN concept design includes advanced information enabling technologies (i.e., digitization and software re-programmable radios) to support battlefield visualization and real-time information flow.[55] Overall the ACN concept provides: limited user access to a new digital cellular radiotelephone service [QUALCOMM Code Division Multiple Access (CDMA) CONDOR System]; a T1 satellite reach-back link to the continental U.S. or to forces beyond line-of-site (i.e., power-projected forced entry forces or over-the horizon carrier battle groups); a relay for the Global Broadcast Service (GBS); and an Ultra-High Frequency (UHF) line-of-sight and surrogate satellite capability.[56] Figure 7 depicts the capabilities incorporated in the ACN concept.[57]

Currently, pre-hostility, enroute and entry operations rely on fragile single channel satellite and CNR communications links to monitor, relay and provide limited C4I support. Pre-hostility communications are limited to current C4I systems without a capability to surge to meet the communications demand during a crisis. Strategic, operational and tactical level commands compete for limited local and national communications resources forcing many deploying units to resort to use of tactical communications (figure 8).[58] During enroute and entry operations forces rely on an Airborne Command and Control Center (ABCCC) with an onboard joint/combined battle staff and austere vehicular mounted communications with single channel satellite and CNR communications links to monitor, relay and provide limited C4I support (figure 9 and 10).[59] The ACN will bolster this austere C4I connectivity efficiently and effectively across the operational continuum. Its impact can be event oriented rather than time or duration oriented as the U.S. Army Signal Center suggests.[60]

The ACN concept provides a moderate capacity C4I surge and relay capability for increased communications demand during a crisis or contingency. The ACN operations add robustness, mobility and range extension to the current C4I infrastructure. The results are improved C4I support to the future force commander and a capability assisting the force in gaining information superiority. Commanders and battle staffs will be free to operate on the move or in locations (such as in hardened land based command centers or aboard command and control ships like the Atlantic Command's USS Mount Whitney) where robust redundant C4I support infrastructures exists to better enable information superiority. Figure 11 portrays the Haiti scenario with the deployment of an HAE UAV or ACN.[61] The potential ACN coverage for both Haiti and Desert Storm are illustrated at appendix C (pages C-9 and C-11).[62] Though the current ACN concept stipulates that multiple ACN are cross-linked to overlap footprint coverage to enhance user access, the concept falls short of providing assured common-user digital voice and data access to "bitways" of a networked system of ACNs.

Threats

Threats to the ACN include electromagnetic and physical threats to HAE UAV and/or to the onboard payload communication systems. Electromagnetic threats include: electronic degradation, interception, and exploitation of communication signals; high altitude electromagnetic pulse (HEMP); directed energy weapons (DEW); and jamming.[63] Physical threats include the effects of direct and indirect fire weapons, the effects of chemical and nuclear weapons and the environment. Threats also exist through software and virus (cyber) corruption from both hostile and non-hostile sources.[64] Special operations missions directed at friendly airfields are a significant ACN threat.[65]

Limitations

The ACN concept may be limited by joint, multinational, and host nation rules, regulations and agreements for frequency assignments.[66] Currently, the use of digitization technologies recognizes the analog interoperability requirements to interface with non-digitized forces and civilian agencies.[67] The ACN's two dependent subsystems (the airborne platform and the communications node) are required to operate in concert to achieve success.[68] It must be able to interface with digitized voice and data communications networks and connect with Integrated System Controls (ISYSCON).[69] The communications payload must be modular in order to migrate between a variety of current and future airborne platforms.[70]

The most significant limitation in this concept is that the ACN will only function as a relay and/or extension of current Battlefield Operating Systems (BOS). In order to support large theaters or sustained operations multiple ACNs will be required to meet C4I needs. This requires cross-linking of ACNs in order to enlarge digital cellular service and overlapping communications footprints.[71] Though it provides cellular reach-back capability, the HAE UAV/ACNs are themselves not fully networked (appendix D, page D-24).[72] The U.S. Army's "Warfighter Information Network" (WIN) implementing the Army's "Systems of Systems" concept would be amiss if it were not to include a system or "formation" of networked HAE UAV/ACNs providing full common user access to future networks and "bitways". A system of a networked 'beyond-HAE UAV/ACNs,' providing joint forces access to "bitways" and beyond-ATM networks, would be the "plasma-like" network "grid" between terrestrial and space based subsystems of the "System of Systems" concept.

WARFIGHTER INFORMATION NETWORK (WIN)

Background

The WIN is the U.S. Army Signal Corps force modernization vision. The WIN concept capitalizes on the information technology revolution to fulfill the Army's "System of Systems" concept (appendix D).[73] WIN is an evolving, integrated C4I network designed to increase the capacity and velocity of information distribution throughout the battlespace in order to gain information dominance.[74] WIN will provide advanced information services to the warfighter and support future power projection forces.[75]

The WIN is an architecture of primarily commercially based, advanced technology, information and communications systems consisting of six major sub-systems or components: power projection sustaining base; satellite communications; information systems/services; terrestrial transport; tactical internet CNR; and network management.[76] WIN's goal is to integrate these six subsystems/components into a viable high speed information distribution network infrastructure (using ATM IP networks combined with computer/information systems and a variety of transmission media). WIN attempts to capitalize on the concept of "bitways" and the convergence of telecommunications and computer systems discussed earlier in this study.

WIN and ACN

As a sub-component of the WIN, the ACN assists in rapid C4I network installation, supports force projection and supports forces isolated from the main force. Even more viable to WIN would be the recommended system of networked common-user accessed beyond-HAE UAV/ACNs. Note that the ACN is not referred to as a sub-system or major component of WIN. The ACN is depicted as a sub-component of tactical internet CNR. The ACN communications payload carries a CNR relay and Personal Communications Service

(PCS) system that provides range extension (relay and connectivity) capabilities. The ACN uses gateways and bridges (black box technology) for communications interfacing but is not networked with other ACNs or networks (appendix D, pp. D-9, D-24/25, D-30/31).[77] This is significant because gaining information dominance depends on having "networks of networks" forming an "information grid" of the "System of Systems" to pass information over "bitways" anywhere and to any device or user that is authorized and requires it.

THE FUTURE: NETWORK-CENTRIC WARFARE

Background

The 'networks of networks' forming the "information grid" of the "System of Systems" for the Force and/or Army After Next is encompassed in JV2010. The emerging operational concepts of JV2010 can be enabled by advanced information/communication architectures that interconnect the capabilities of sensors, command and control, and shooters.[78] In other words, these emerging operational concepts are "centered" on "networks" of sensors, command and control, and shooters. Thus, the emerging operational concepts of JV2010 are "Network-Centric" and JV2010 Warfare can be characterized as "Network-Centric Warfare."[79]

"Network-Centric Warfare" is a by-product of "network-centric computing."[80] The growth and change from "platform-centric computing" to "network-centric computing" has been made possible by advanced information technology.[81] The current information technological revolution is directly related to the merger of telecommunications and computing discussed earlier in this study. The emerging concepts of "Network-Centric Warfare" will exploit information superiority to provide a competitive edge in warfare for the Force After Next: information dominance.

The operational architectures connecting sensors, command and control, and shooters to increase combat power through information flow can be represented by a "Network-Centric Warfare Grid."[82] This grid has three sub-architectures: an information grid, a sensor grid and an engagement grid. These emerging operational architectures are depicted in figures 12 and 13.[83]

Information Grid

The "System of Systems" construct of this study falls within the information grid. The information grid provides the infrastructure for network-centric computing and communications and the means to receive, process, transport, store, and protect information for the force.[84] A key capability inherent in the information grid is information assurance: the prevention of intrusion or cyber attack and the assurance of information validation.[85]

The information grid is a fundamental building block of the "Systems of Systems" leading to information superiority and eventually information dominance. The information grid is a terrestrial-air-space based "network of networks" consisting of communications pipes/paths, computation/control nodes, operating systems, and information management applications (see figures 14 and 15).[86] Together, they enable network-centric computing/ communications and provide essential information access and transport (i.e., dial-, data-, and web-tone) throughout the battlespace.[87] The information grid enables both the sensor grid's battlefield awareness and the engagement grids applications/peripherals/weapons systems capabilities to dominate the battlespace.[88]

PROPOSED "SYSTEMS OF SYSTEMS" AND CONCLUSION

Implementation and Operational Methodology

The future U.S. armed forces "System of Systems" must be implemented using the concepts discussed within this study.

These concepts will ensure the network-centric application of warfare enabling the Force and/or Army After Next to obtain and maintain information dominance. To accomplish this end, the services must implement information infrastructure "System of Systems," "network of networks," and "bitways" standardization. Further, recommend that: the services endorse the Army's WIN as the standard methodology for the "System of Systems" concept approach; the current and proposed national strategic satellite program focus efforts on providing 'large capacity common user bitways' networks; and a high capacity "bitways" networked system of beyond-HAE UAV/ACN be implemented as the seventh major component of the WIN.

For WIN to be accepted as the standard approach for the "System of Systems" it must take advantage of ATM and Internet (and beyond) technology over the full complement of transmission media over terrestrial-, space- and aerial-based "networks of networks" to provide a complete, flexible and assured information grid. Though WIN development is progressive, it must incorporate the new information operations technology paradigm merging telecommunications and computing to provide generic "bitways" and standard protocols to access them. The foundations for Network-Centric Warfare can be achieved following this rational.

Further, the current and proposed national or military geocentric/stationary satellite system must be of the same architecture providing large "bitways" globally. With the terrestrial backbone (strong skeletal) and space based (outer skin) C4I networks and "bitways," the WIN has a robust yet vulnerable design. The WIN architecture, even with dynamic bandwidth allocation, lacks the capability to surge without maintaining reserve resources or placing an even greater demand and reliance on the commercial information infrastructure. This creates inefficiencies within the "System of Systems" and the WIN remains susceptible to, and less able to protect or isolate itself from, the inherent vulnerabilities of the civilian infrastructure. Further, not only would maintaining reserve network switching and satellite "bitways" and access capacity lead to inefficient "System of Systems" use, once used these resources would be difficult to return to a reserve state.

The 'beyond-WIN' can overcome these deficiencies by including an operational networked system HAE (disposable, recoverable or reusable) UAV/ACNs as the seventh major component of the current WIN concept. This beyond-ACN networked aerial "bitways" system would be the 'plasma-like' system to provide for the required C4I surge during peace- and war-time deployments.

The C4I infrastructure is subject to 'networking holes:' where and when portions of the terrestrial or space based "System of Systems" and or civilian information infrastructure fail due to physical or cyber disruption. The 'plasmatic beyond-ACN' network provides the critical capability to fill these C4I 'networking holes.' Although, currently there are physical payload and antenna constraints, the exponential growth of micro-and nano-technology will prove virtually limitless over time for increased beyond-ACN C4I payload capacity and throughput. For example, the current space-based position-location systems can be supplemented or even replaced in times of disruption by like systems embedded in the beyond-ACN payload.

Based on the implementation of the above "System of Systems" "network of networks" "information grid" it will become possible to provide a comprehensive large volume digital C4I 'umbrella' or 'cylinder' over a deployed military force throughout its battle space. This C4I umbrella or cylinder system of networked terrestrial-, aerial- and space-based systems will provide smart, expert and brilliant communications, for digital voice and/or data tactical-to-strategic, computer-to-computer, sensor-to-weapon and weapon-to-weapon systems creating synergy between battlespace awareness, enhanced command and control, and precision force. If required, the deployed force would be capable of operating less dependent on the civilian information and networking infrastructure. The capability of the plasmatic beyond-ACN network to 'fill in,' skip, or bypass degraded or disrupted 'network-holes' provides physical, electronic and cyber intrusion security enabling assured information superiority or information dominance. This "System of Systems" concept will enable the Force After Next to achieve the "Knowledge and Speed," the "Linear to Vertical C4I" and the "Air-Ground Maneuver" "Operational Characteristics" for the Army After Next (AAN) (see figures 16-18).[89]

Operationally, recommend that the service components of U.S. Space Command plan for, program, maintain and provide the beyond-HAE UAV/ACNs forces to the warfighting Force After Next commanders and that the Defense Information Systems Agency (DISA) provide network management and control. These beyond-HAE UAV/ACNs forces would provide the 'plasma-like' C4I connectivity between the terrestrial or space based "System of Systems" completing the large volume digital C4I 'umbrella' or 'cylinder' over a deployed military force throughout its battlespace. The future "System of Systems" now provides access to a "bitways" networked information grid. Future spread spectrum and adaptive bandwidth and routing technologies applied over a full complement of transmission media (terrestrial-, space- and aerial-based "networks of networks") provides a complete, flexible and assured information grid for a deploying force throughout the operational continuum. Further, this future "System of Systems" has the capability to serve the nation in concert with other federal agency systems in times when the civilian information infrastructure degrades or is required to surge to meet local or national demands (such as natural disasters and the Olympic Games).

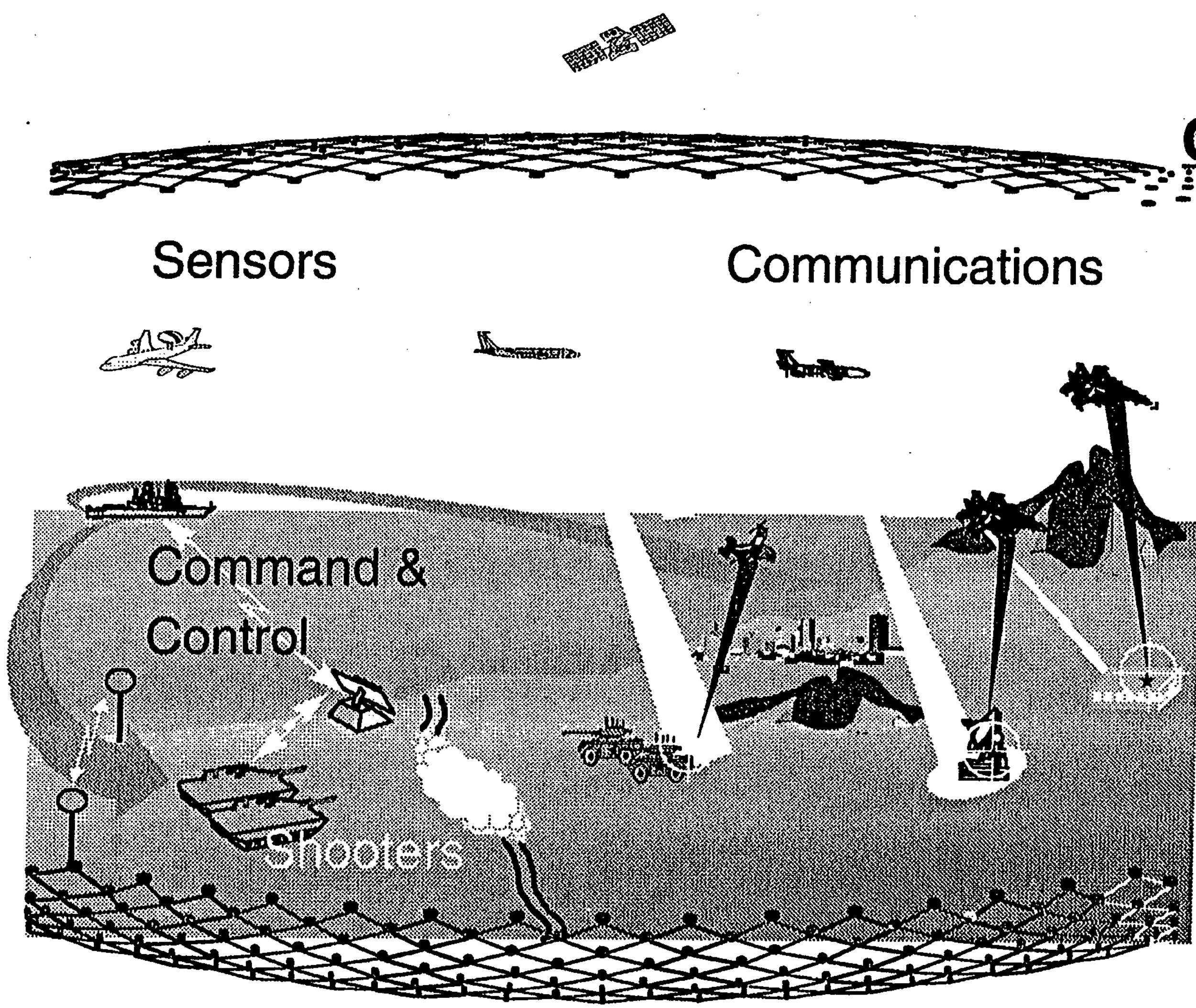
Conclusion

This study examined National Military Strategy in the area of information dominance through the "System of Systems" concept of the U.S. armed forces. It provides a description of the current U.S. National Security and Military Strategies on information dominance and focuses on the military's "System of Systems" concept towards achieving information dominance. It addresses and analyzes current and future strategic implications and requirements for U.S. warfighting communications and information systems. It proposes a more flexible, reliable, responsive, robust and survivable high capacity throughput communications and "bitways" system to support projection of the Force and/or Army After Next. This methodology implements the "System of Systems" concept to support information dominance.

The purpose of this study was to apply creative and critical thought to current, emerging and potential C4I capabilities and propose a more cost effective and advantageous position to achieve information dominance through the "System of Systems" concept embraced by U.S. National Military Strategy and JV 2010. This study falls well within that domain and provides a design that bests employs the nation's scarce strategic satellite systems, capitalizes on the power of information technology and improves "Systems of Systems" security. Overall, this study supports the exploitation and integration of information technologies with other emerging technologies to implement capabilities that give the future U.S. armed forces a decisive advantage.

6081

Joint Vision 2010



Emerging Operational Concepts

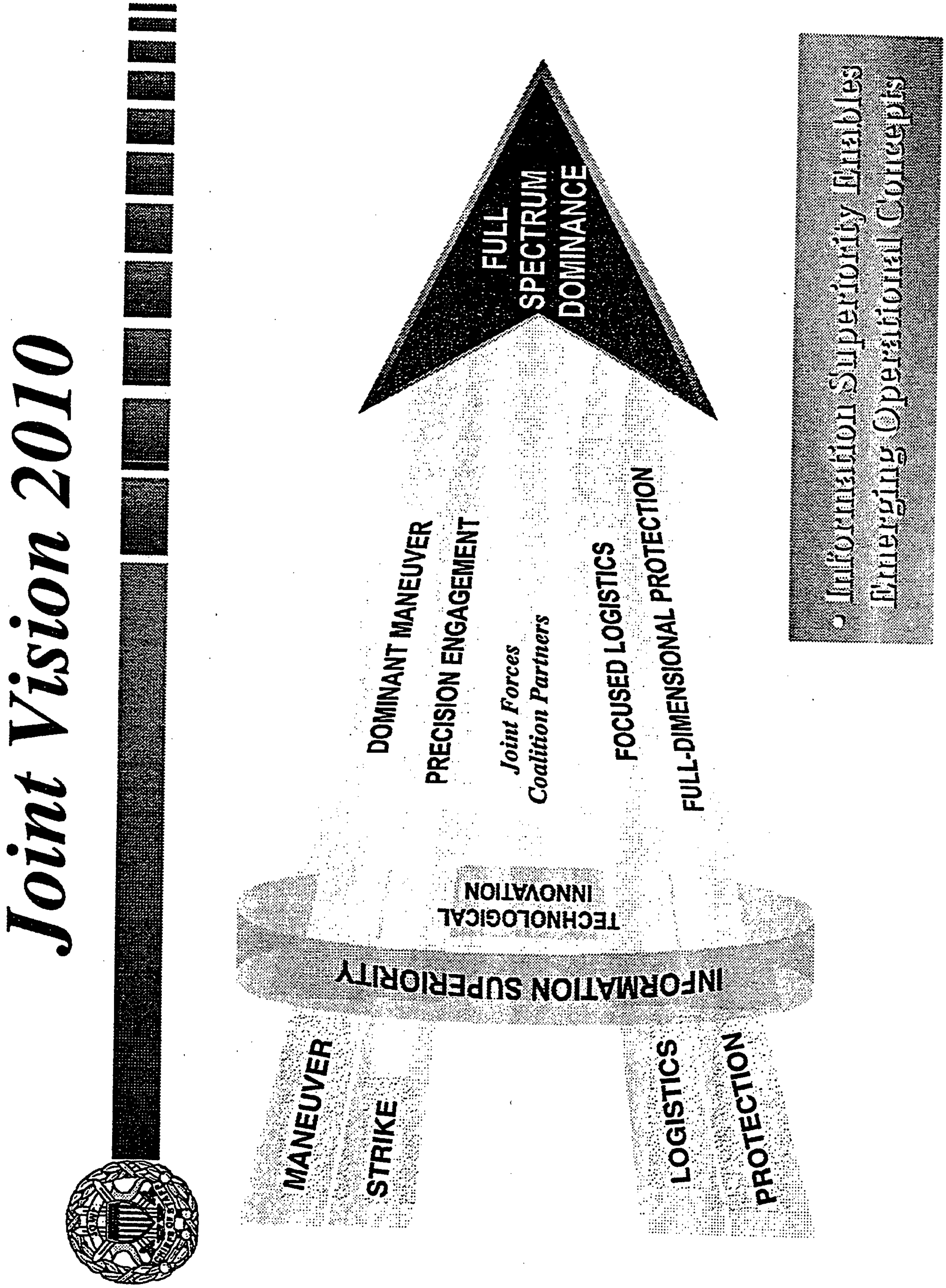
- Dominant Maneuver
- Precision Engagement
- Focused Logistics
- Full-Dimensional Protection

Enabled by

- Information Superiority

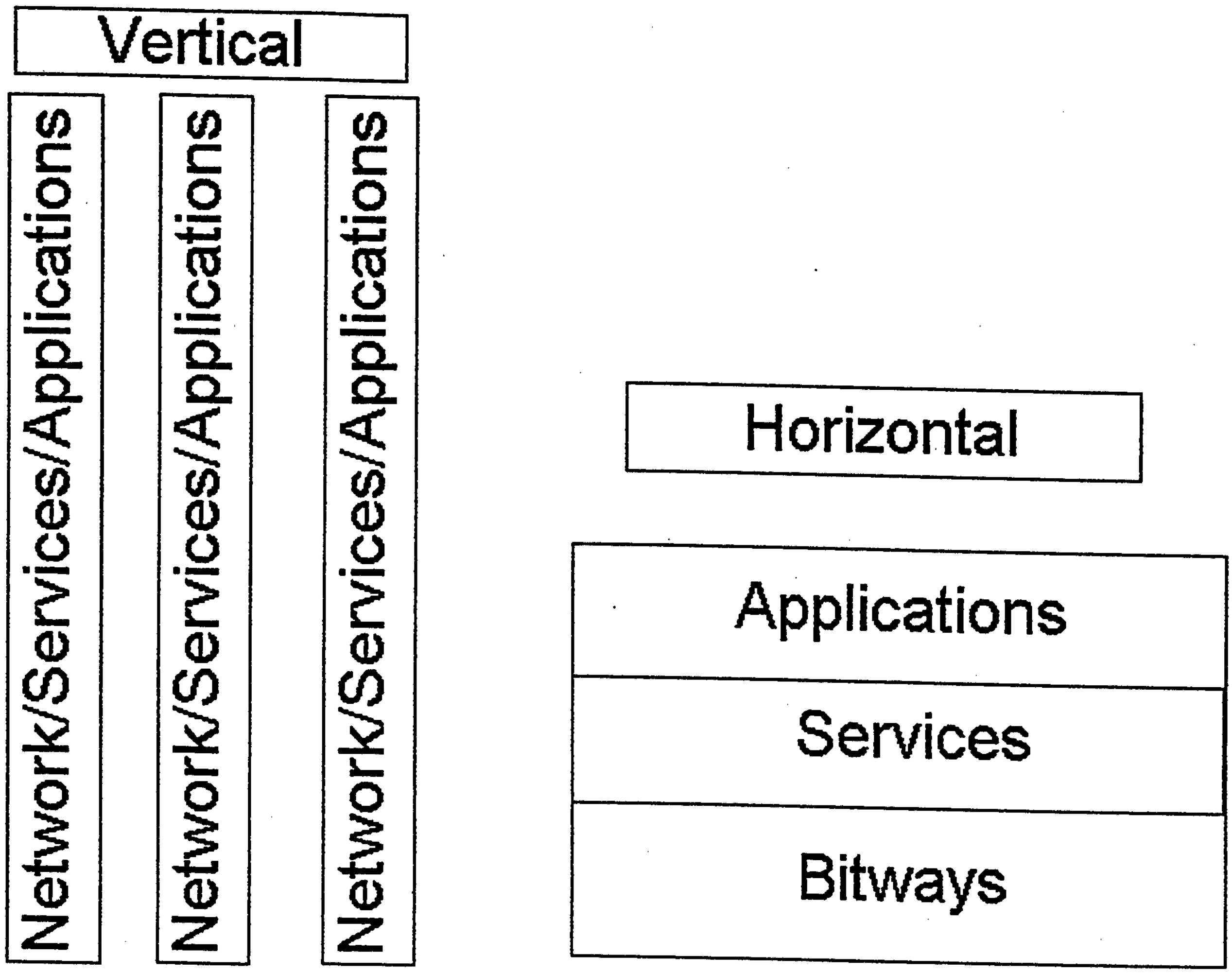
Joint Vision 2010 Emerging Operational Concepts Figure 1

Appendix A



Joint Vision 2010 Full Spectrum Dominance

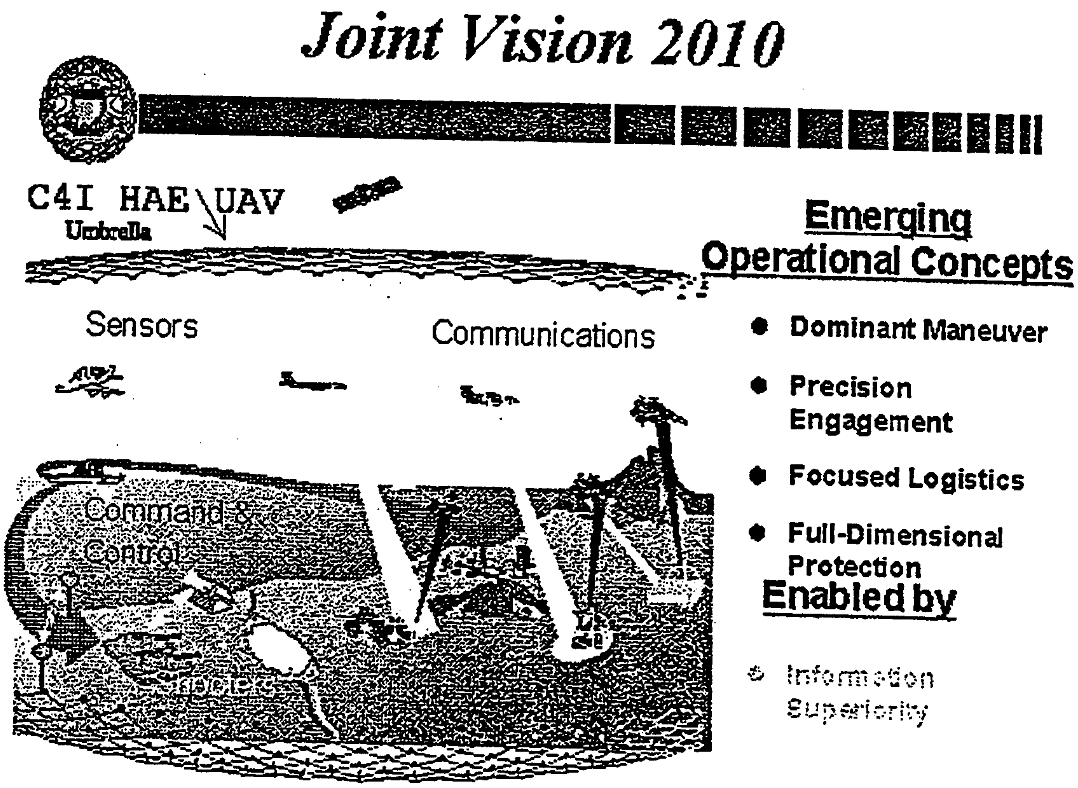
Figure 2



Existing stovepiped architecture model for providing networks and their associated services and applications. A vertical integrated model. Black-box or numerous gateways and bridges are required to move information horizontally between networks.

A three-layer network model for providing horizontal integration of bitways, services and applications. Integrating horizontally allows the integration of diverse media within each application as well as diverse applications within each bitway. An integrated-services network.

Vertical VS Horizontal Network Integration   Figure 3



This "C4I umbrella" would provide capacity to transport large volumes of digital information supplementing and lowering reliance on the Nation's strategic satellite system before, during and after force deployment.

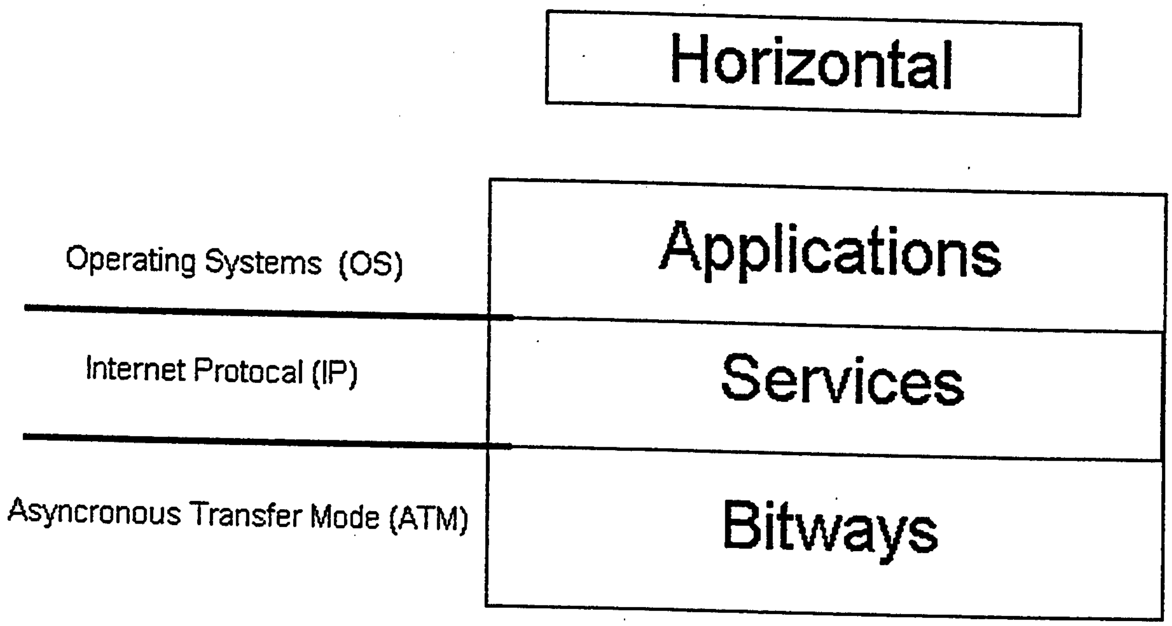
A networked system/formation of remote controlled Unmanned Aerial Vehicle's (UAV's) could provide smart, expert and brilliant communications, for digital voice and/or data tactical-to-strategic, computer-to-computer, sensor-to-weapon and weapon-to-weapon systems creating synergy between battle space awareness, enhanced command and control, and precision force.

Joint Vision 2010 with a C4I HAE UAV Umbrella

Figure 4

Network Applications and Examples

Function \ Temporal relationship	Immediate	Deferred
User-to-information-service or other i.e. weapons or sensor system	Video on demand WWW browsing Realtime targeting data	File transfer Historical data
User-to-user or other i.e. weapons or sensor system	Real time telephony Video conferencing Voice recognition	Electronic mail Voice mail

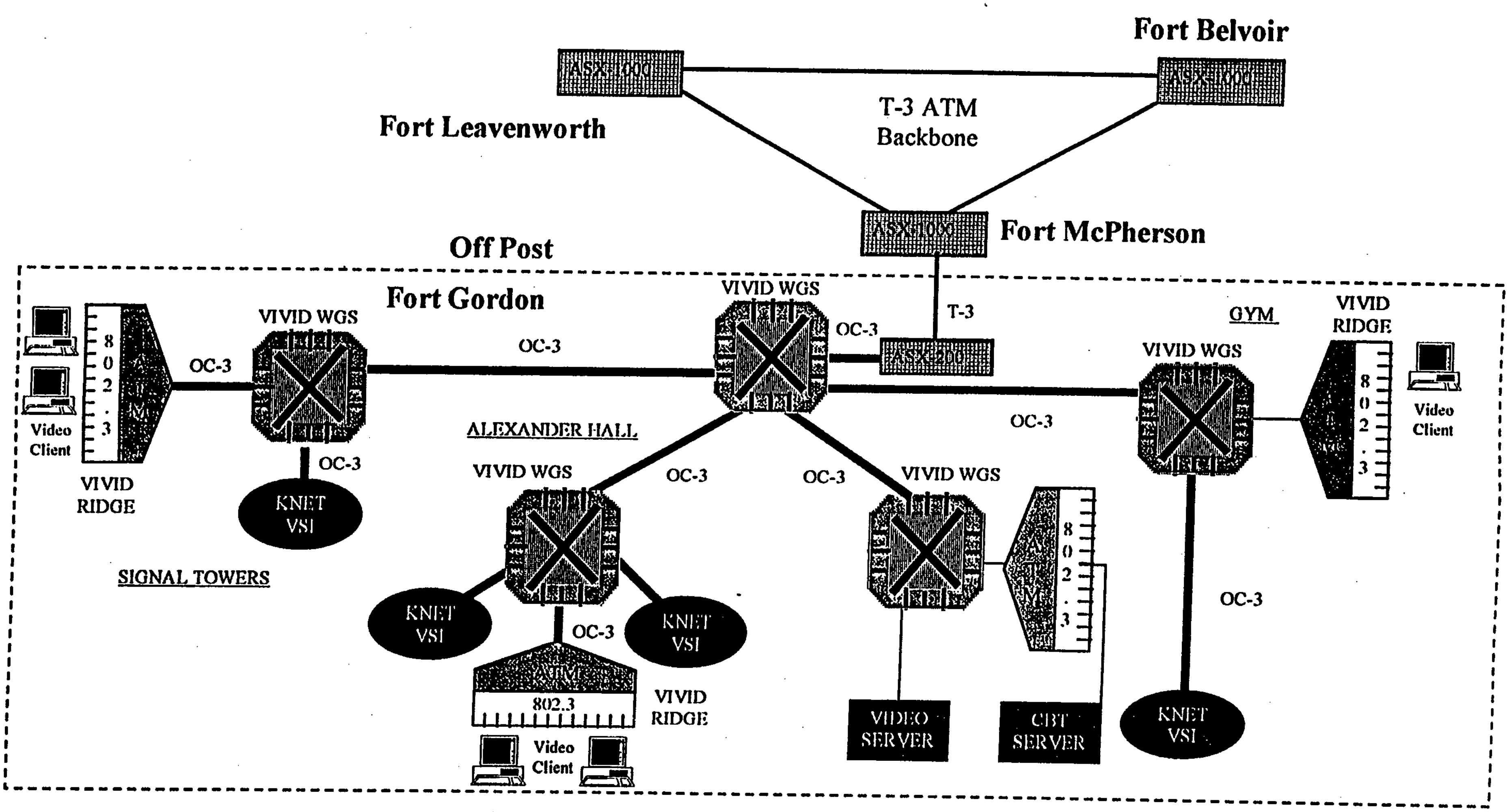


A three-layer network model for providing horizontal integration of bitways, services and applications. Integrating horizontally allows the integration of diverse media within each application as well as diverse applications within each bitway. An integrated-services network.

Three-Layer Network Model

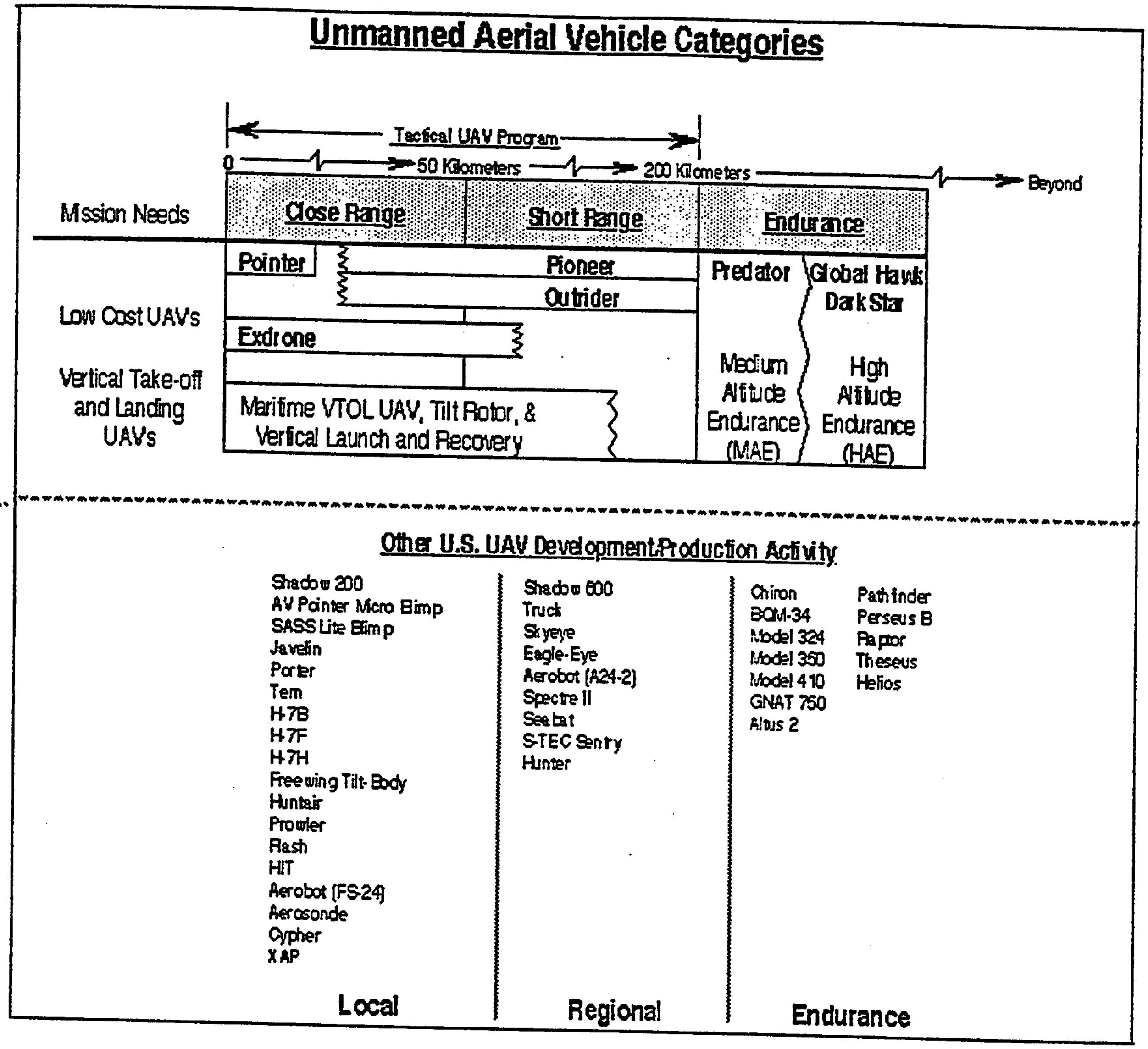
Figure 5

US Army Signal Center and Fort Gordon Asynchronous Transfer Mode (ATM) Network



US Army Signal Center and FT Gordon ATM Network Figure 6

Unmanned Aerial Vehicles



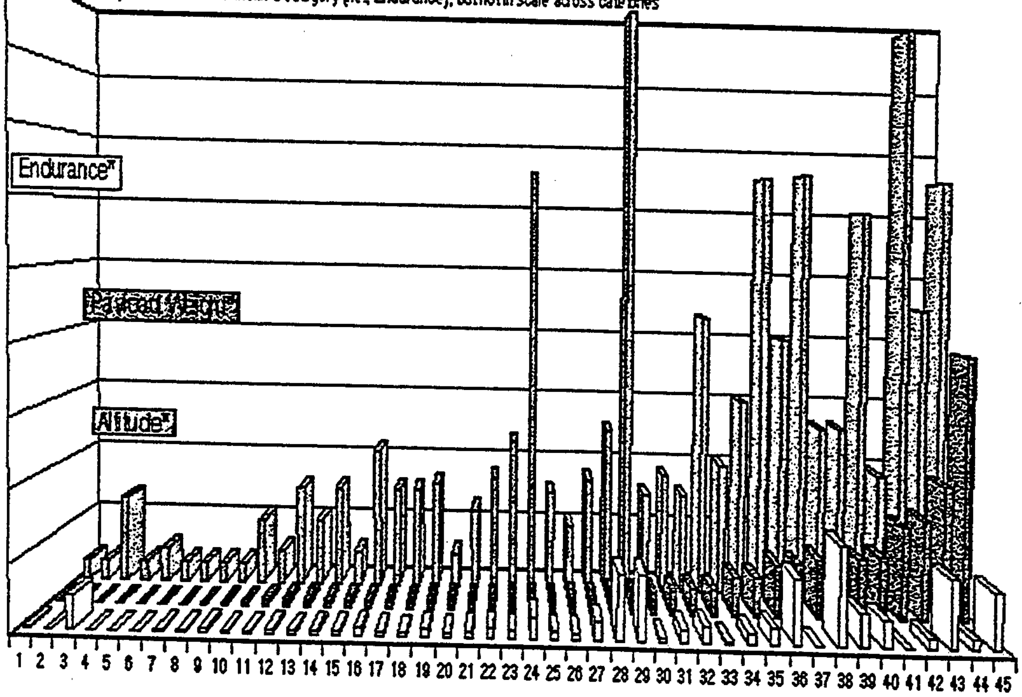
Observational Science Branch; Laboratory for Hydrospheric Processes
NASA GSFC/Wallops Flight Facility
NASA Official 972/Laurence C. Rossi, Maintained by CSC/Jeff Lee.

NASA GSFC/Wallops Flight Facility UAV Categories Table 2

#	Unmanned Aerial Vehicle	Hours Endurance	Pounds Payload Weight	Feet Altitude Capability
1	AV Pointer Micro Blimp	2	1.5	3000
2	AV Pointer	1	2	3000
3	Aerosonde	24	22	13000
4	H-7B	1	3	3000
5	XAP	1	4	5000
6	H-7H	1	5	3000
7	Javelin	1.5	6	3000
8	H-7F	2	12	3000
9	Tern	4	22	3000
10	Exdrone	2.5	25	10000
11	Cypher	2.5	45	5000
12	Freewing	3.5	50	15000
13	Seabat	3	50	10000
14	Shadow 200	4	50	15000
15	Truck	4	50	5000
16	Prowler	6	50	21000
17	MK-105 Flash	4	60	15000
18	MK-106C HIT	3	60	15000
19	STM-5B	6	75	16000
20	Porter	4	75	5000
21	Pioneer	5.5	75	12000
22	Huntair	7.5	80	17000
23	Spectre II	6	85	23000

#	UAV	Hours Endurance	Pounds Payload Weight	Feet Altitude Capability
24	Pathfinder	16	88	65000
25	A24-2	6	90	15000
26	SASS Lite Blimp	5	100	9850
27	Shadow 600	14	100	17000
28	Gnat 750	48	140	25000
29	Helios	48	150	90000
30	Outrider	4	160	15000
31	Skyeye	10	175	18000
32	Hunter	12	200	15000
33	Model 324	2.5	200	43000
34	Eagle Eye	8	300	20000
35	Model 410	12	300	30000
36	Raptor	48	397	65000
37	Model 350	1	400	40000
38	Perseus B	72	441	65620
39	Altus 2	24	450	26000
40	Predator	20	450	26000
41	BQM-34	1.25	470	60000
42	Chiron	8	700	19000
43	Theseus	50	750	82500
44	DarkStar	8	1000	45000
45	Global Hawk	42	1960	65000

*Data plotted is in scale within a category (i.e., Endurance), but not in scale across categories



Observational Science Branch; Laboratory for Hydrospheric Processes
NASA GSFC/Wallops Flight Facility
NASA Official 972/Laurence C. Rossi, Maintained by CSC/Jeff Lee.

Locations

Database

Capabilities

Questionnaire

Exdrone Test Report (PDF)

About Wallops

WFF Photos

Working (WFF Internal)

OSB Home

WFF Home

Mail Rossi

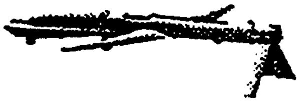
Unmanned Aerial Vehicle Name	Endurance (Hours)	Payload Weight (Pounds)	Altitude Capability (Feet)	Costing Info
AV Pointer	1 hr.	2 lbs.	3,000 ft.	Yes
AV Pointer Micro Blimp	2 hrs.	1.5 lbs.	3,000 ft.	Yes
Aerobot	n/a	n/a	n/a	-
Aerosonde	24 hrs.	2.2 lbs.	13,000 ft.	Yes
Altus 2	24 hrs.	450 lbs.	26,000 ft.	Yes
BQM-34	1.25 hrs.	470 lbs.	60,000 ft.	Yes
Chiron	8 hrs.	700 lbs.	19,000 ft	-
Cypher	2.5 hrs.	45 lbs.	5,000 ft.	-
Darkstar	8 hrs.	1,000 lbs.	45,000 ft.	Yes
Eagle Eye	8 hrs.	300 lbs.	20,000 ft.	-
Exdrone	2.5 hr.	25 lbs	10,000 ft.	-
Firebee	1.25 hrs.	470 lbs.	60,000 ft.	-
Freewing	3.5 hrs.	50 lbs.	15,000 ft.	-
Global Hawk	42 hrs.	1,960 lbs.	65,000 ft.	Yes
Gnat 750	48 hrs.	140 lbs.	25,000 ft.	Yes
Hawk-i 7B	1 hr.	3 lbs.	3,000 ft.	Yes
Hawk-i 7F	2 hrs.	12 lbs.	3,000 ft.	Yes
Hawk-i 7H	1 hr.	5 lbs.	3,000 ft.	Yes
Huntair	7.5 hrs.	80 lbs.	17,000 ft.	Yes
Hunter	12 hrs.	200 lbs.	15,000 ft.	-
Javelin	1.5 hrs.	6 lbs.	3,000 ft.	-
Model 324	2.5 hrs.	200 lbs.	43,000 ft.	-
Model 350	1 hr.	400 lbs.	40,000 ft.	-
Model 410	12 hrs.	300 lbs.	30,000 ft.	-
Outrider	4 hrs.	160 lbs.	15,000 ft.	Yes
Pathfinder	16 hrs.	88 lbs.	70,000 ft.	-
Perseus B	72 hrs.	441 lbs.	65,620 ft.	-
Pioneer	5.5 hrs.	75 lbs.	12,000 ft.	Yes
Porter	4 hrs.	75 lbs.	5,000 ft.	Yes
Predator	20 hrs.	450 lbs.	26,000 ft.	Yes
Prowler	6 hrs.	50 lbs.	21,000 ft.	-
Raptor	48 hrs.	397 lbs.	65,000 ft.	-
SASS Lite	5 hrs.	100 lbs.	9,850 ft.	-
STM-5B	6 hrs.	75 lbs.	16,000 ft.	-
Seabat	3 hrs.	50 lbs.	10,000 ft.	-
Shadow 200	4 hrs.	50 lbs.	15,000 ft.	-
Shadow 600	14 hrs.	100 lbs.	17,000 ft.	-
Skyeye	10 hrs.	175 lbs.	18,000 ft.	-
Spectre II	6 hrs.	85 lbs.	23,000 ft.	-
Tern	4 hrs.	22 lbs.	3,000 ft.	-
Theseus	50 hrs.	750 lbs.	88,500 ft.	-
Truck	4 hrs.	50 lbs.	5,000 ft.	Yes

Edit the UAV Database (Restricted Access).

	CHARACTERISTICS	Pioneer	Hunter	Tactical UAV Outrider
Operational	ALTITUDE: Maximum (km, ft)	4.6 km 15,000 ft	4.6 km 15,000 ft	4.6 km 15,000 ft
	Operating (km, ft)	≤4.6 km ≤15,000 ft	≤4.6 km ≤15,000 ft	1.5 km 5,000 ft
	ENDURANCE (Max): (hrs)	5 hrs	11.6 hrs	>4 hrs (+reserve @ 200 km)
	RADIUS OF ACTION: (km, nm)	185 km 100 nm	267 km 144 nm	≥200 km ≥108 nm
	SPEED: Maximum (km/hr, kts)	204 km/hr 110 kts	196 km/hr 106 kts	204 km/hr 110 kts
	Cruise (km/hr, kts)	120 km/hr 65 kts	>165 km/hr >89 kts	167 km/hr 90 kts
	Loiter (km/hr, kts)	120 km/hr 65 kts	<165 km/hr <89 kts	111-139 km/hr 60-75 kts
	CLIMB RATE (Max): (m/min, fpm)	[N/A] [N/A]	232 m/min 761 fpm	488 m/min 1,600 fpm
	DEPLOYMENT NEEDS:* *Depends on equipage & duration	Multiple* C-130, C-141, C-17, or C-5 sorties Ship: LPD	Multiple* C-130 sorties	Single C-130 (drive on/drive off) Ship: LHA/LHD (roll on/roll off)
Air Vehicle	PROPULSION: Engine(s)	One recip: 2 cylinders, 2-stroke	Two recips 4 stroke	One recip, pusher prop
	- Maker	-Sachs & Fichtel SF 2-350	-Moto Guzzi (Props: 1 pusher/1 puller)	-McCulloch 4318F Short Block/Diesel
	- Rating	19 4 kw 26 hp	44.7 kw 60 hp	37.3 kw 50 hp
	- Fuel	avgas (100 octane)	mogas (87 octane)	Heavy fuel (JP-8)
	- Capacity (L, gal)	42/44.6 L 11/12 gal	189 L 50 gal	48 L 12.7 gal
	WEIGHT: Empty (kg, lb)	125/138 kg 276/304 lb	544 kg 1,200 lb	136 kg 300 lb
	Fuel weight (kg, lb)	30/ 32 kg 66/ 70 lb	136 kg 300 lb	39 kg 85 lb
	Payload (kg, lb)	34/ 34 kg 75/ 75 lb	91 kg 200 lb	27 kg 60 lb
	Max takeoff (kg, lb)	195/205 kg 430/452 lb	726 kg 1,600 lb	>227 kg >500 lb
	DIMENSIONS: Wingspan (m, ft)	5 2 m 17.0 ft	8 9 m 29.2 ft	3.4 m 11.0 ft
	Length (m, ft)	4 3 m 14 0 ft	7.0 m 23 0 ft	3.0 m 9.9 ft
	Height (m, ft)	1.0 m 3 3 ft	1.7 m 5 4 ft	1.5 m 5.0 ft
	AVIONICS: Transponder	Mode IIIC IFF	Mode IIIC IFF	Mode IIIC IFF
	Navigation	GPS	GPS	GPS and INS
	LAUNCH & RECOVERY	Land: RATO, rail, runway (A-gear) Ship: RATO; deck w/net	RATO, unimproved runway (200 m)	75m x 30m x 10m "box" (dependent on weight and altitude)
	GUIDANCE & CONTROL:	Remote control/preprogrammed	Remote control/preprogrammed	Prepgmd/remote con/autopilot & -land
Payload & Links	SENSOR(S):	EO or IR	EO or IR	EO or IR (SAR growth
	DATA LINK(S): Type	Uplink: C-band/LOS & UHF Downlink: C-band/LOS	C-band/LOS	C-band/LOS (digital growth)
	Bandwidth: (Hz)	C-band/LOS 10 MHz UHF: 600 MHz	20 MHz	4.4-5.0/5 25-5.85 GHz
	Data rate: (bps)	C-band/LOS & UHF: 7,317 kbps	7,317 kbps	Full duplex: 9,600 baud
	C2 LINK(S):	Through data link	Through data link	Through data link
	SYSTEM COMPOSITION:	5 AVs, 9 payloads (5 day cameras, 4 FLIRs), 1 GCS, 1 PCS, 1-4 RRSs, 1 TML (USMC unit only)	8 AVs, 8 MOSPs, 4 ADRs, 4 RVTs, 3 GCSs/MPSs, 2 GDTs, 1 LRS, 1 MMF	4 AVs, 2 GCSs, 2 GDTs, 1 RVT, 4 MMPs, LRE, GSE
	PRIME/KEY CONTRACTOR(S):	Pioneer UAV, Inc.	TRW Avionics & Surveillance Group	Alliant Techsystems
	MAJOR SUBCONTRACTORS: - Air vehicle, propulsion, avionics, payloads, information-processing, communications, ground and support systems	AAI Corp; Computer Instrument Corp; General Svcs Engrg; Humphrey; Israel Aircraft Industries; Sachs; Trimble Navigation	Alaska Ind.; Burtek; Consolidated Ind.; Fiber Com; Gichner; IAI/Malat; IAI/Elta; IAI/Malat/Tamam; ITT/Cannon; Lopardo: Mechtronics; Moto Guzzi	BendixKing; BMS; Cirrus Design; CDL; FLIR Systems; GS Engineering, IAI Tamam; IntegriNautics; Lockheed Martin, Mission Technologies; Phototelesis-TI; Rockwell International; SwRI; Stratos Group; Teftec Inc.
	Column Notes:	AV weights: Option 2/Option 2+		Developmental estimates

ure 26. Comparison of the characteristics of the six UAVs.

Summer 1997

Tier II, MAE UAV *Predator*	Tier II+, CONV HAEUAV *Global Hawk*	Tier III-,LO HAE UAV *DarkStar*
7.6 km *25,000 ft* 4.6 km *15,000 ft* >20 hrs 926 km *500 nm* 204-215 km/hr *110-115 kts* 120-130 km/hr *65- 70 kts* 111-120 km/hr *60- 65 kts* 168 m/min *500 fpm* Multiple* C-130 sorties	19.8 km *65,000 ft* 15.2 - 19.8 km *50,000 - 65,000 ft* >40 hrs (24 hrs at 5,556 km/*3,000nm*) 5,556 km *3,000 nm* >639 km/hr *>345 kts* 639 km/hr *345 kts* 630 km/hr *340 kts* 1,036 m/min *3,400 fpm* AV: self-deployable GS: multiple* C-141, C-17, or C-5 sorties	>13.7 km *>45,000 ft* >13.7 km *>45,000 ft* >8 hrs (at 926 km/*500 nm*) >926 km *>500 nm* >463 km/hr *>250 kts* >463 km/hr *>250 kts* >463 km/hr *>250 kts* 610 m/min *2,000 fpm* Multiple* C-141, C-17 or C-5 sorties
One fuel injected recip; 4-stroke -Rotax 912/Rotax 914 63.4/75 8 kw *85/105 hp* avgas (100 octane) 409 L *108 gal* 544 kg *1,200 lb* 295 kg *650 lb* 204 kg *450 lb* 1,043 kg *2,300 lb* 14.8 m *48.7 ft* 8.1 m *26.7 ft* 2 2 m *7.3 ft* Mode IIIC IFF GPS and INS Runway (760 m/*2,500 ft*) Prepgmd/remote control/autonomous	One turbofan -Allison AE3007H 32 kN *7,050 lb static thrust* Heavy fuel (JP-8) 8,176 L *2,160 gal* 4,055 kg *8,940 lb* 6,668 kg *14,700 lb* 889 kg *1,960 lb* 11,612 kg *25,600 lb* 35 4 m *116.2 ft* 13.5 m *44.4 ft* 4.6 m *15.2 ft* Mode I / II/ IIIC / IV IFF GPS and INS Runway (1,524m/*5,000 ft*) Preprogrammed/autonomous	One turbofan -Williams FJ 44-1A 8.45 kN *1,900 lb static thrust* Heavy fuel (JP-8) 1,575 L *416 gal* 1,978 kg *4,360 lb* 1,470 kg *3,240 lb* 454 kg *1,000 lb* 3,901 kg *8,600 lb* 21.0 m *69 ft* 4.6 m *15 ft* 1.5 m *5 ft* Mode IIIC IFF GPS and INS Runway (1,219 m/*<4,000 ft*) Preprogrammed/autonomous
EO, IR & SAR C-band/LOS; UHF/MILSATCOM; Ku-band/SATCOM C-band/LOS: 20 MHz UHF/MILSATCOM: 25 kHz Ku-band/SATCOM: 5 MHz C-band/LOS: 20 MHz Analog UHF/MILSATCOM: 4.8 kbps Ku-band/SATCOM: 1.544 Mbps UHF/MILSATCOM	EO IR & SAR Ku-band/SATCOM; X-band CDL/LOS UHF/SATCOM 25 MHz Ku-band SATCOM: 2.2-72 MHz X-band/CDL/LOS: 10-120 MHz UHF/SATCOM: 19.2 kbps Ku-band/SATCOM: 1.5-50 Mbps X-band CDL/LOS: 274 Mbps UHF MILSATCOM: Ku-band/SATCOM; UHF/LOS; X-band CDL/LOS	EO or SAR Ku-band/SATCOM; X-band CDL/LOS UHF/SATCOM: 25 kHz Ku-band SATCOM: 2 2 MHz X-band/CDL/LOS: 10-60 MHz UHF/SATCOM: 19 2 kbps Ku-band/SATCOM. 1 5 Mbps X-band CDL/LOS: 137 Mbps UHF MILSATCOM: Ku-band/SATCOM; UHF/LOS; X-band CDL/LOS
4 AVs, 1 GCS, 1 Trojan Spirit II Dissemination System, GSE General Atomics-Aeronautical Systems Boeing Defense & Space; Litton; LMTCS (Ku-band SATCOM); Magnavox/ Carlyle Gp; Northrop Grumman (SAR); Rotax CP; Versatron Cp	AVs (TBD); HAE CGS Teledyne Ryan Aeronautical Allison Engine/Rolls Royce; Raytheon E-Systems; GDE Systems/Tracor; Héroux; Hughes Aircraft; Lockheed Martin Wideband Systems; Rockwell International; Aurora Flight Sciences	AVs (TBD); HAE CGS Lockheed Martin Skunk Works/ Boeing Military Aircraft Division ABS Cp; Advanced Composites; Aydin Vector; CI Fiberite; Hexcel; Honeywell Avionics; Litton G&C; Lockheed Martin Wideband Systems; Recon/Optical; Rock- well Collins; Rosemount Aerospace; Northrop Grumman; Williams International

Developmental estimates

LEGEND

ADR	Air data relay
A-Gear	Arresting gear
AV	Air vehicle
Avgas	Aviation gasoline
CDL	Comon data link
CGS	Comon ground segme
EO	Electro-optical
FLIR	Forward-looking infra
GCS	Ground-control station
GDT	Ground-data terminal
GPS	Global Positioning Sys
GSE	Ground-support equip
HAE	High-altitude enduranc
IFF	Identification friend or
INS	Inertial navigation syst
IR	Infrared
JP	Jet petroleum
kHz	Kilohertz
LHA	Landing helicopter amphibious
LHD	Landing helicopter doc
LOS	Line-of-sight
LPD	Landing platform dock
LRE	Launch & recovery equipment
LRS	Launch & recovery system
MAE	Medium-altitude endurance
MHz	Megahertz
MMF	Mobile maintenance facility
MMP	Modular mission payloa
Mogas	Mobility gasoline
MOSP	Multimission optronic stabilized payload
MPS	Mission-planning statio
PCS	Portable control station
RATO	Rocket-assisted takeoff
RRS	Remote receiving statio
RVT	Remote video terminal
SATCOM	Satellite communication (military)
TML	Truck-mounted launche
UHF	Ultra-high frequency

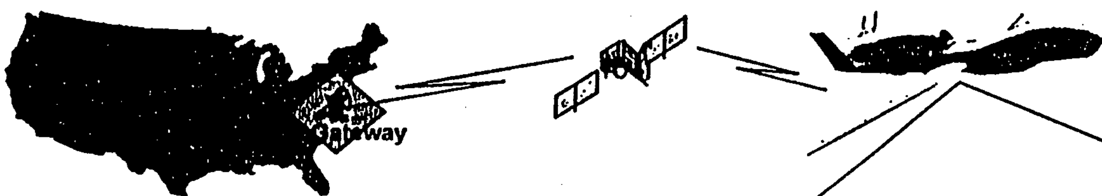
Army Communicator
Table 5b
Appendix A

Airborne Communications Node

Warfighting Capabilities:

An Aerial Communications Payload That Provides:
- Over the Horizon Communications
- Reachback Connectivity,
- Communications On the Move
- Gateways for Seamless Communications

ACN Support
- **Early Entry**
- **Deep Ops**
- **Major Offensive Ops**

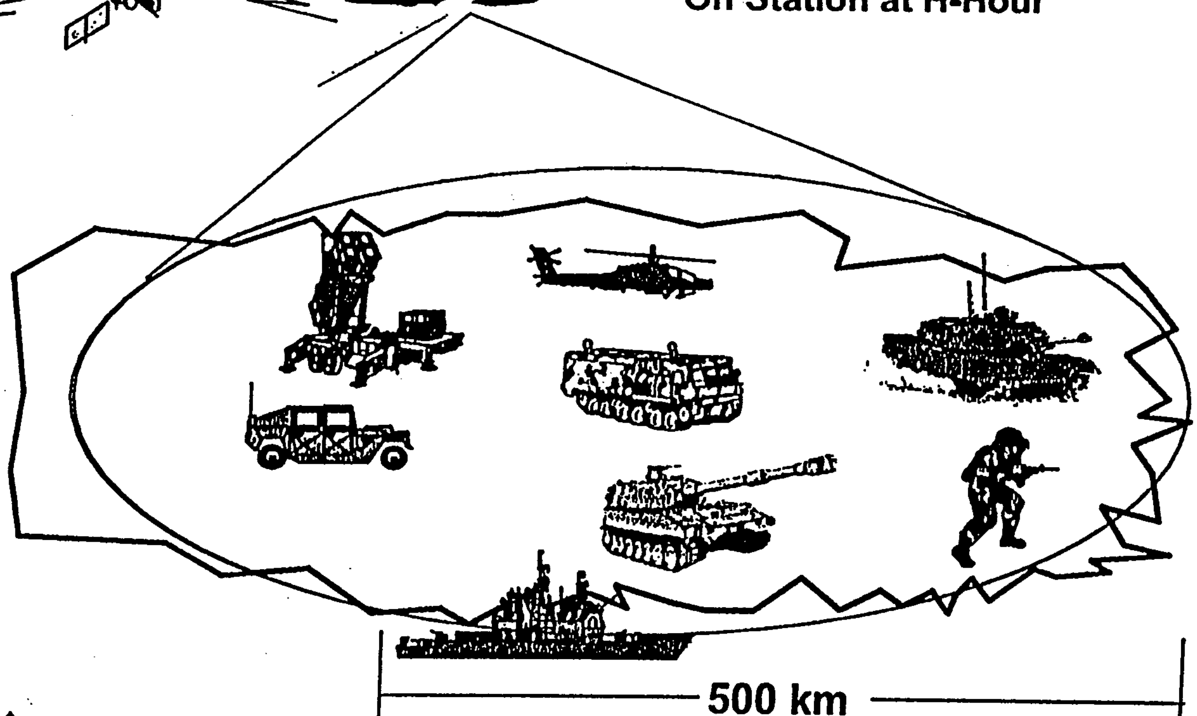


On Station at H-Hour

- Reduces Army's Dependence on Terrestrial Relays

- Provides:
  - Cellular/PCS
  - SINCGARS/TI RETRANS
  - UHF RETRANS
  - T1 Reachback to Power Projection Platform
  - FDR/HCTR Relay

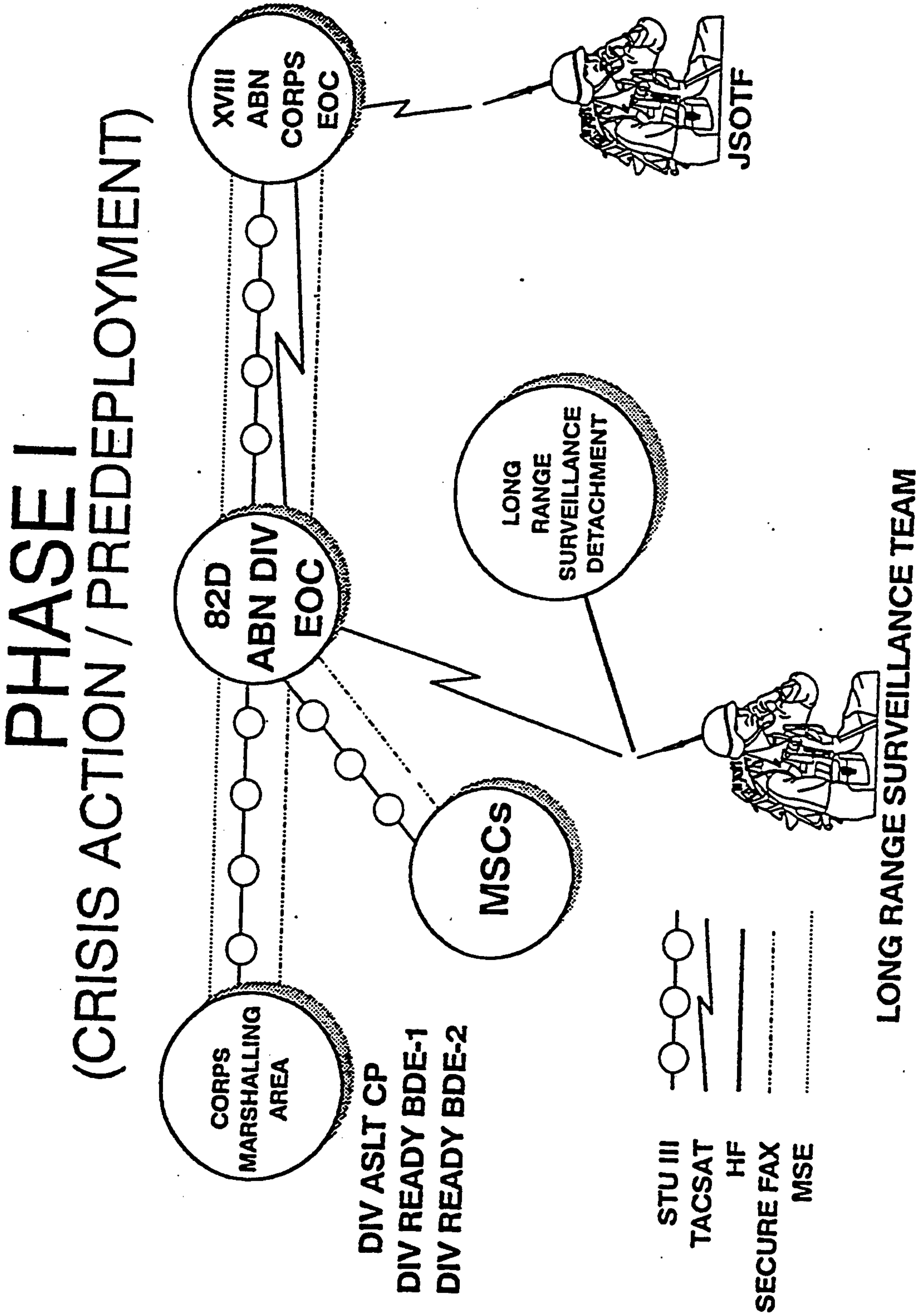
- C2 On-The-Move
- Small User Antennas



United States Army Signal Center

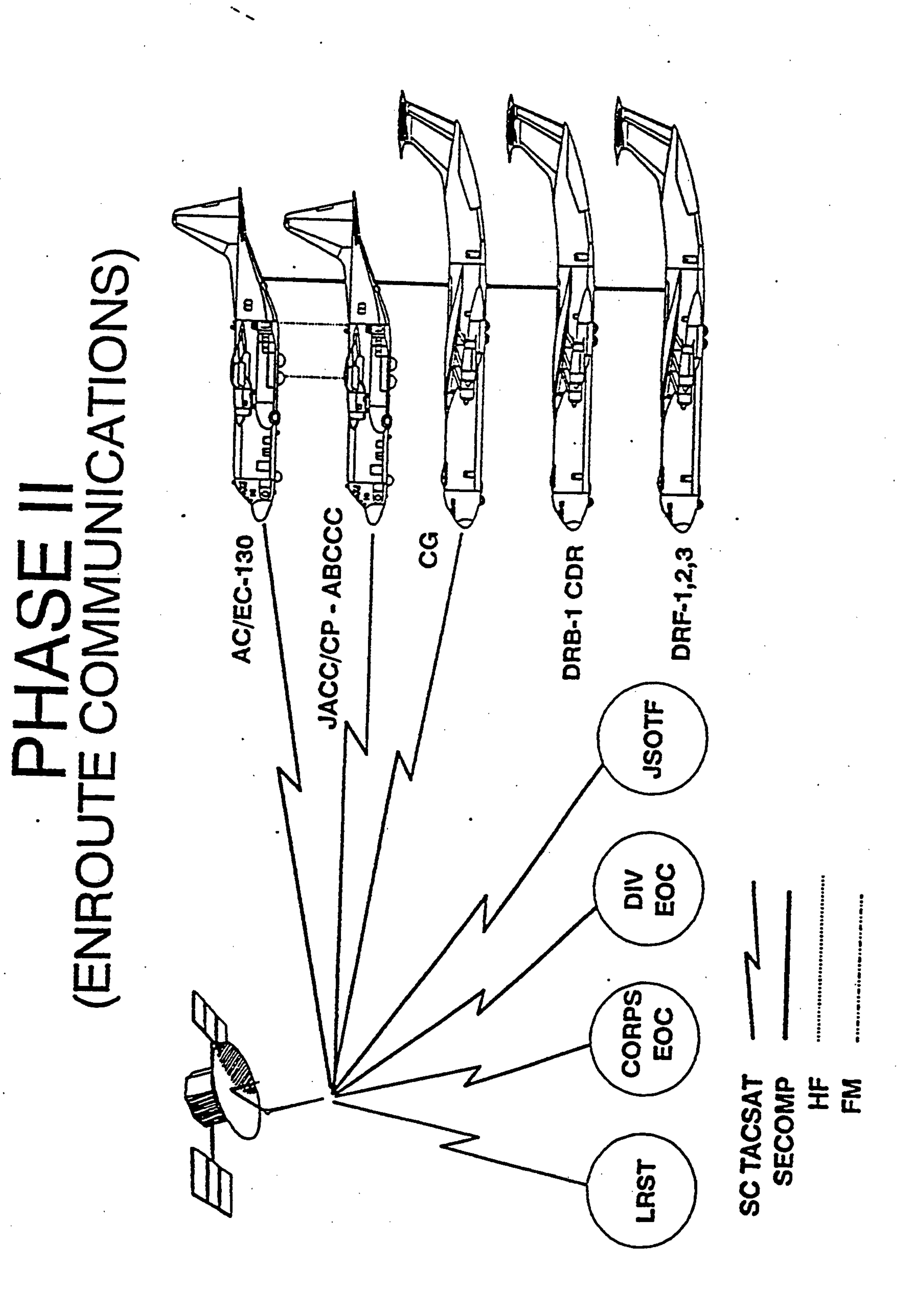
Airborne Communications Node (ACN) Capabilities

Figure 7
Appendix A



Communications During Phase I (Pre-deployment)

Figure 8
Appendix A

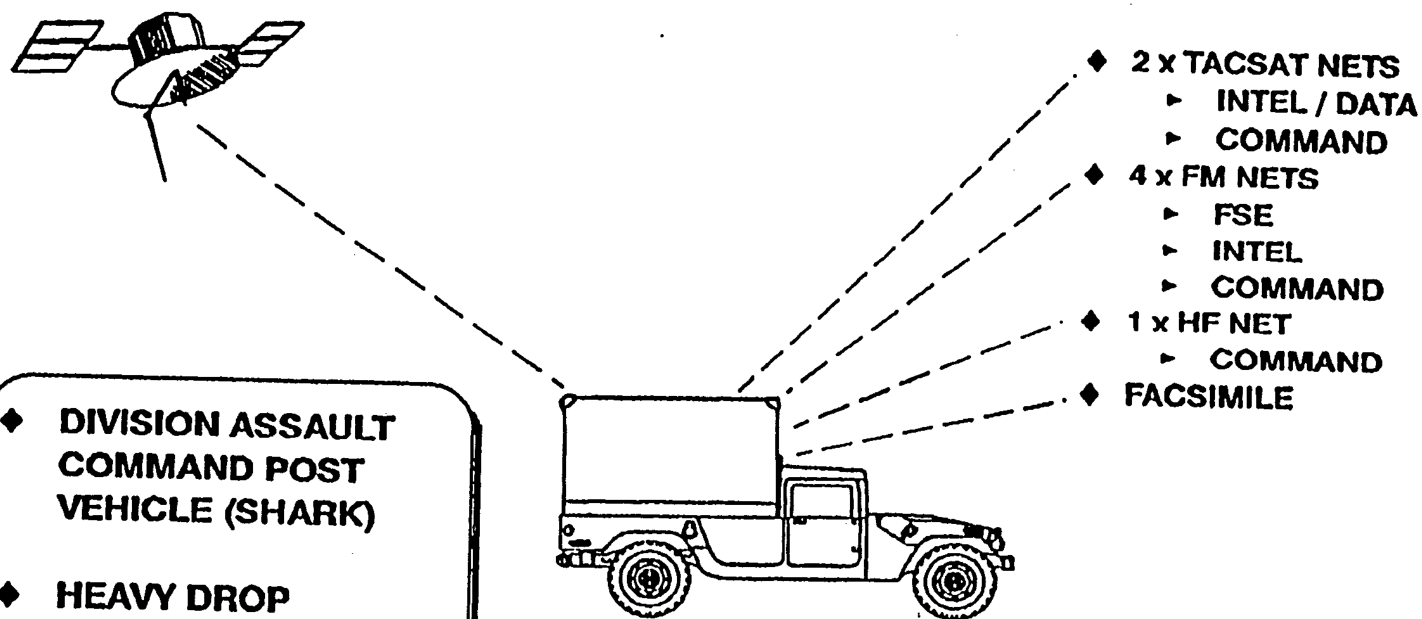


Communications During Phase II (Enroute) Figure 9

Appendix A

PHASE III

SINGLE CHANNEL SYSTEMS REMOTED FROM SHARK TO DIVISION ASSAULT COMMAND POST

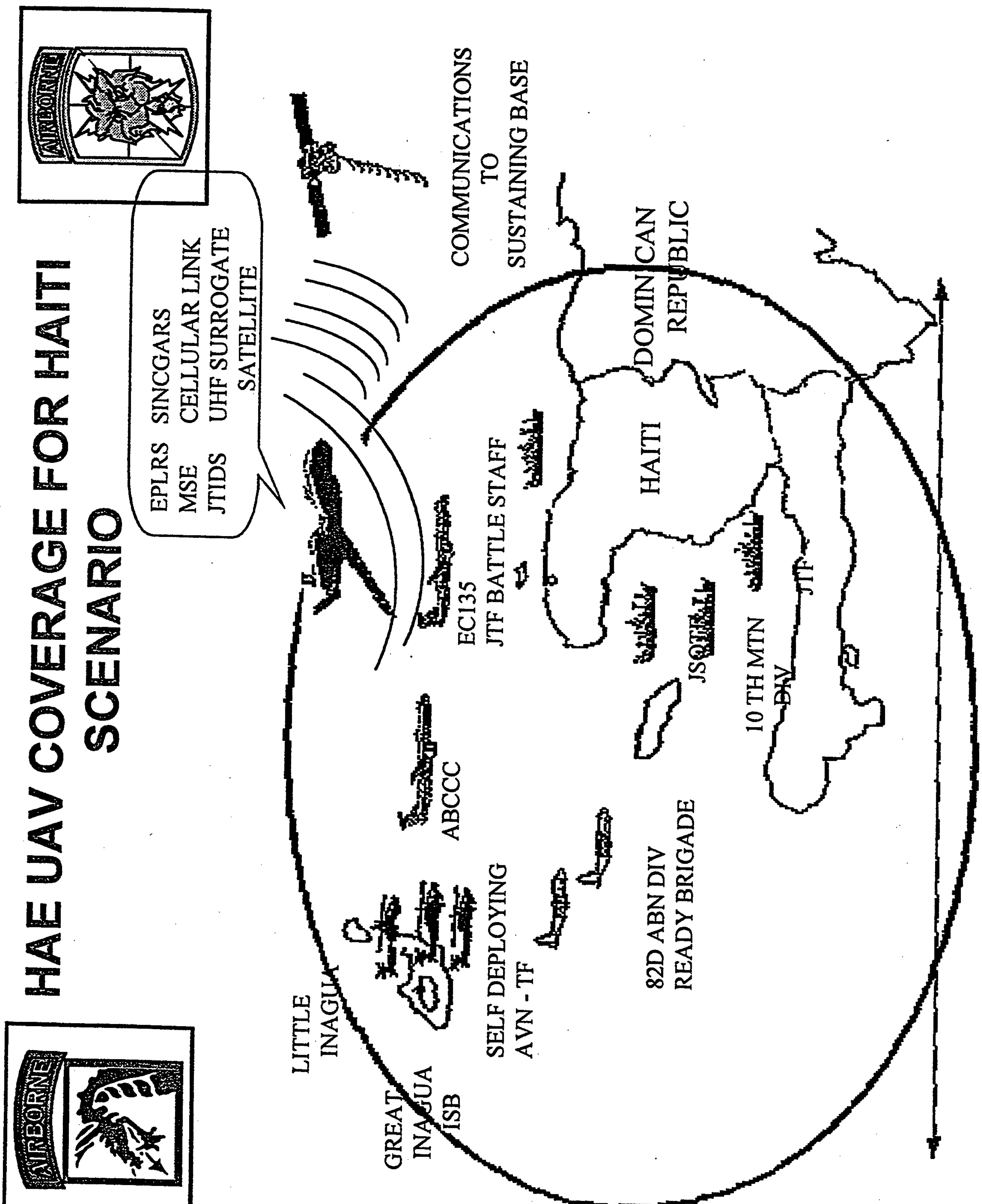


- **DIVISION ASSAULT COMMAND POST VEHICLE (SHARK)**
- **HEAVY DROP**
- **REPLACES MANPACK SYSTEMS**

A-20

Communications During Phase III (Entry)

Figure 10
Appendix A



HAE UAV Coverage for Haiti Scenario

Figure 11

Network Centric Warfare

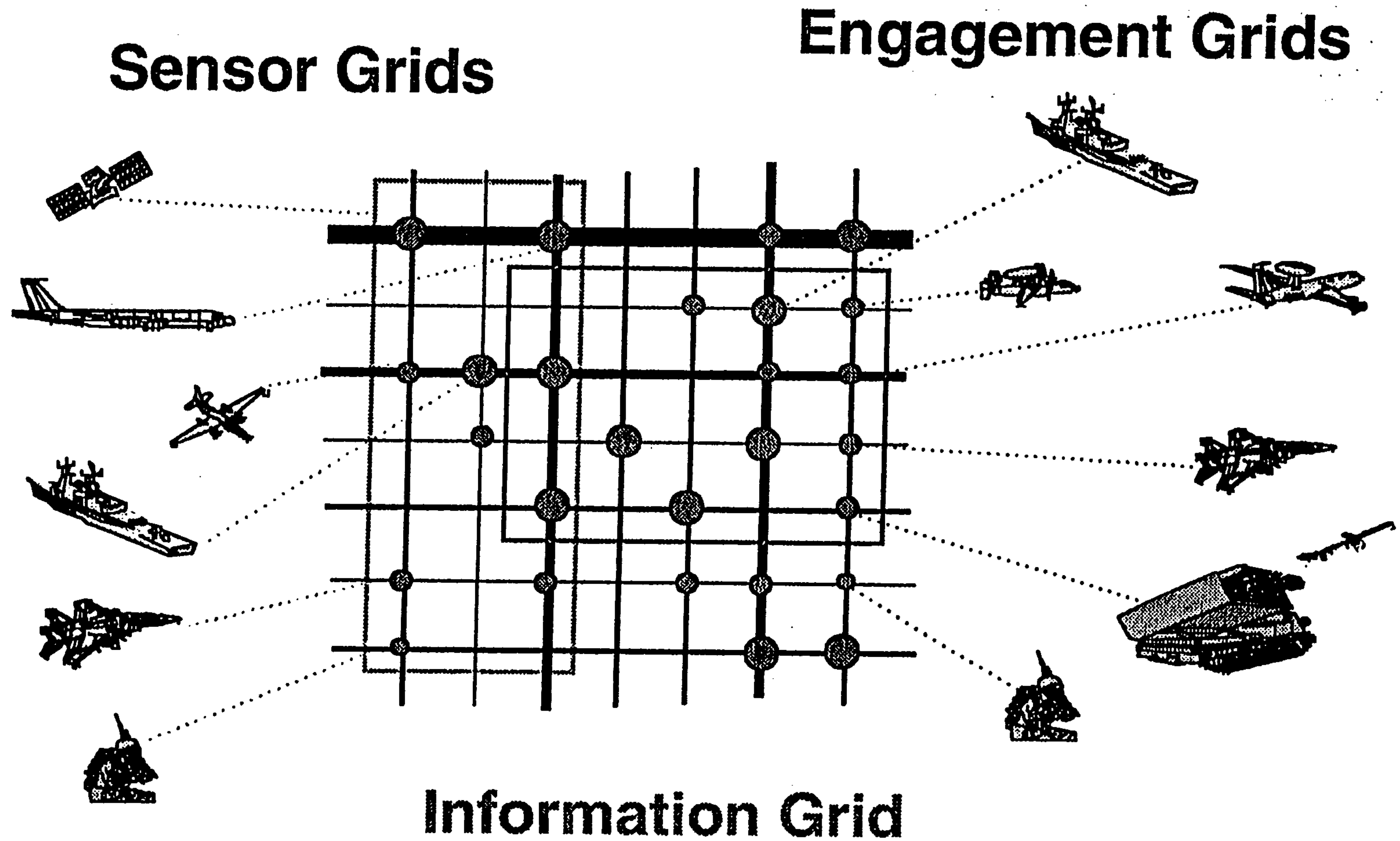
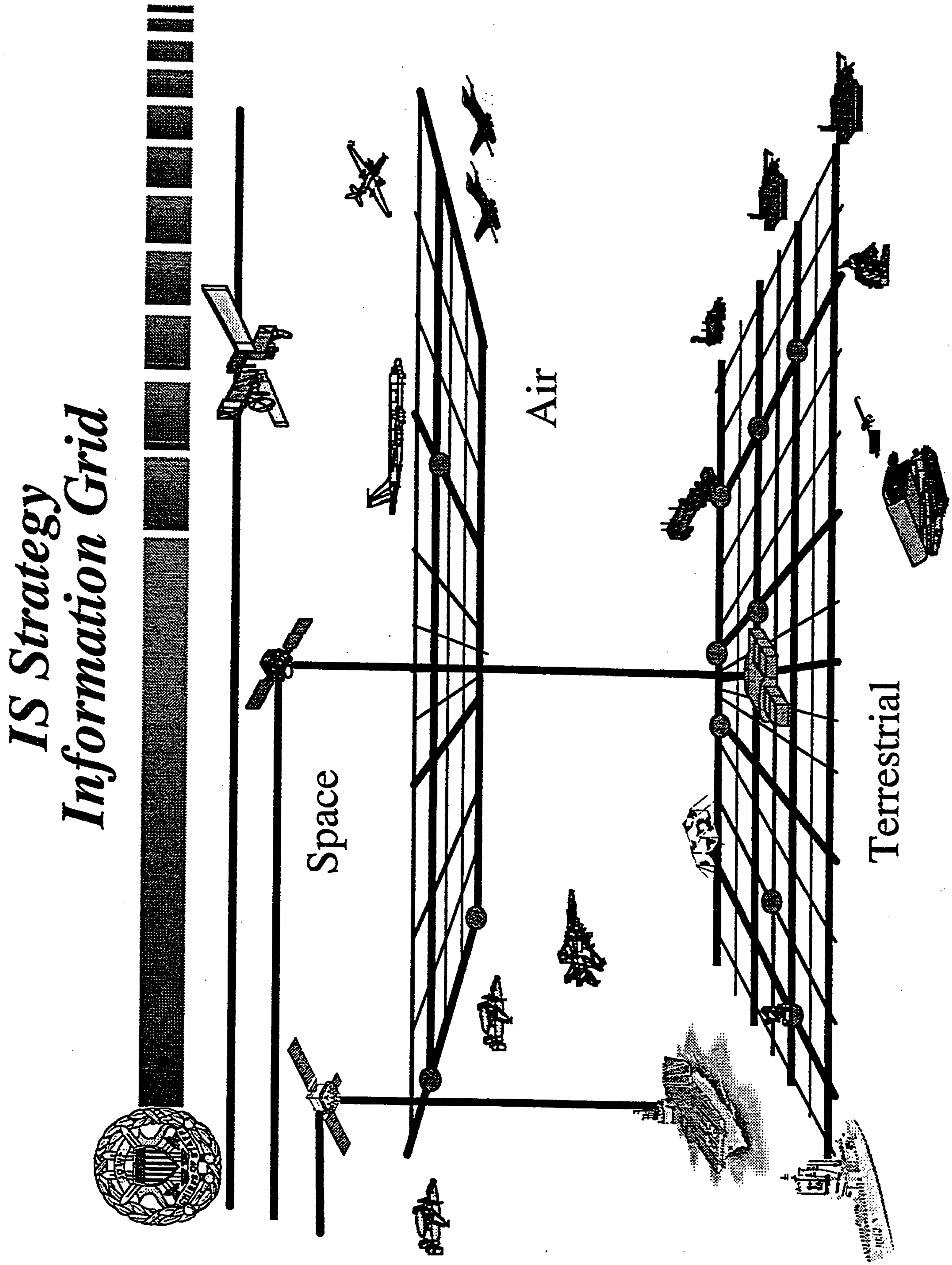


Figure 12
Appendix A

Network Centric Warfare Emerging Insights

- Information Grid
  - Provides computing and communications backplane
  - Enables network centric operational architectures
- Sensor Grids
  - Generate Battlespace Awareness
  - Synchronize Battlespace Awareness with combat operations
  - Increase the Velocity of Information
- Engagement Grids
  - Exploit Battlespace Awareness to generate increased Combat Power
  - Enable massing of effects vs. massing of forces
  - Maximize Joint Combat Power
- Network Centric Warfare
  - Changes the dynamics of competition in warfare
  - Enables Increased Speed of Command
  - Rapidly "Locks Out" Adversary's Courses of Action
  - Provides decisive competitive edge in warfare

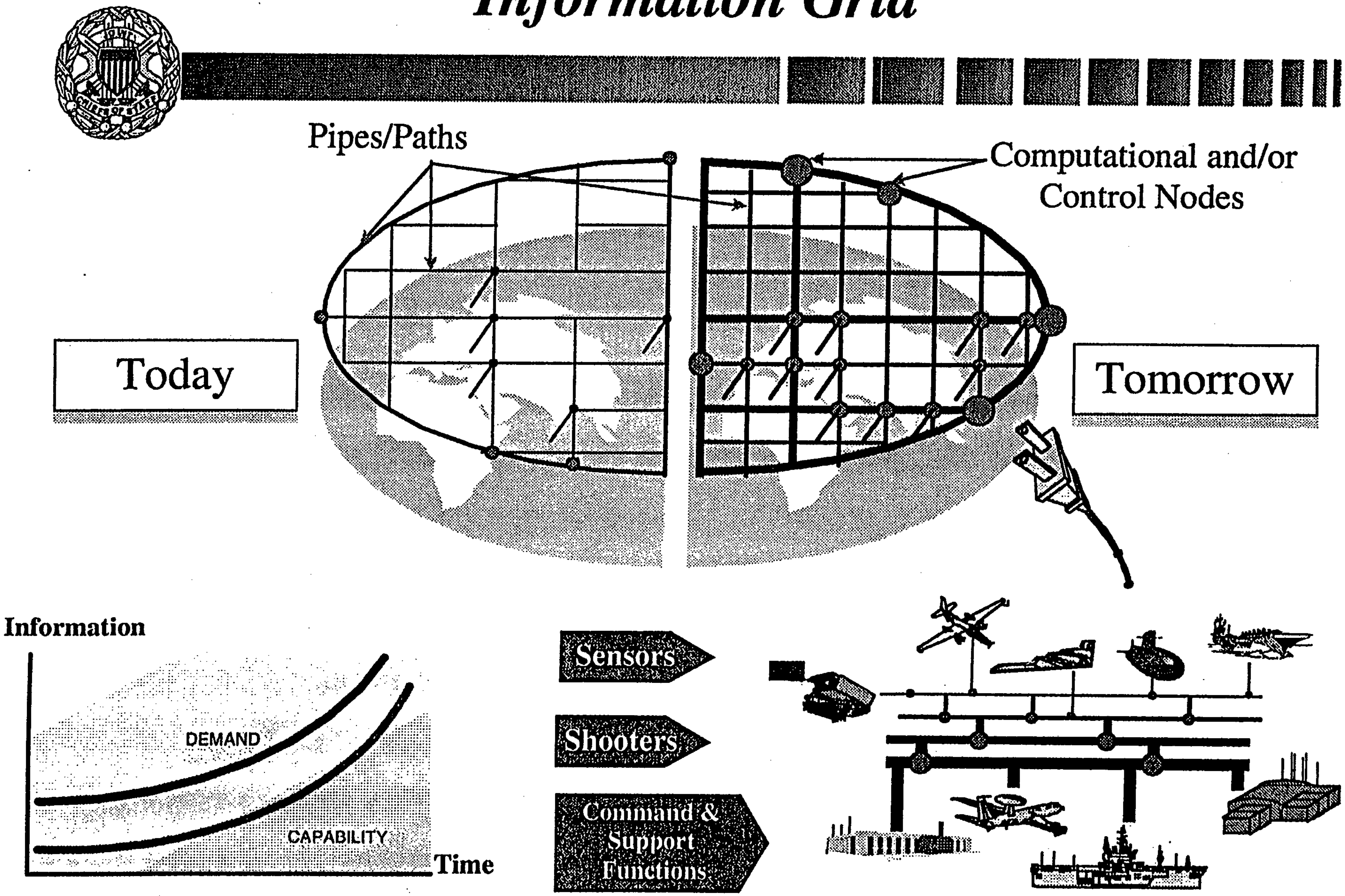
Network Centric Warfare Emerging Insights   Figure 13



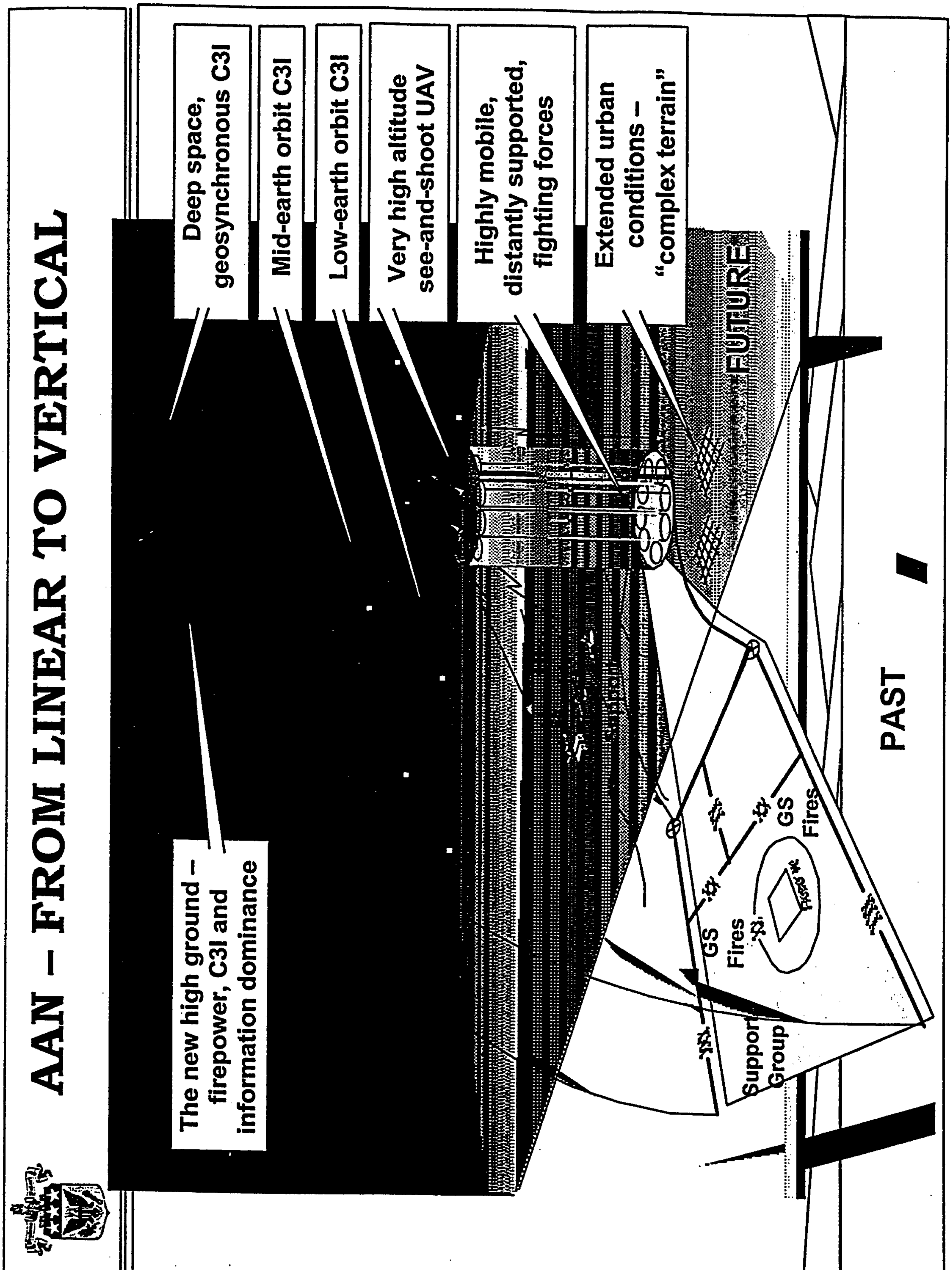
Terrestrial, Air, Space Information Grid

Figure 14

IS Strategy Information Grid



IS Strategy Information Grid
Figure 15
Appendix A

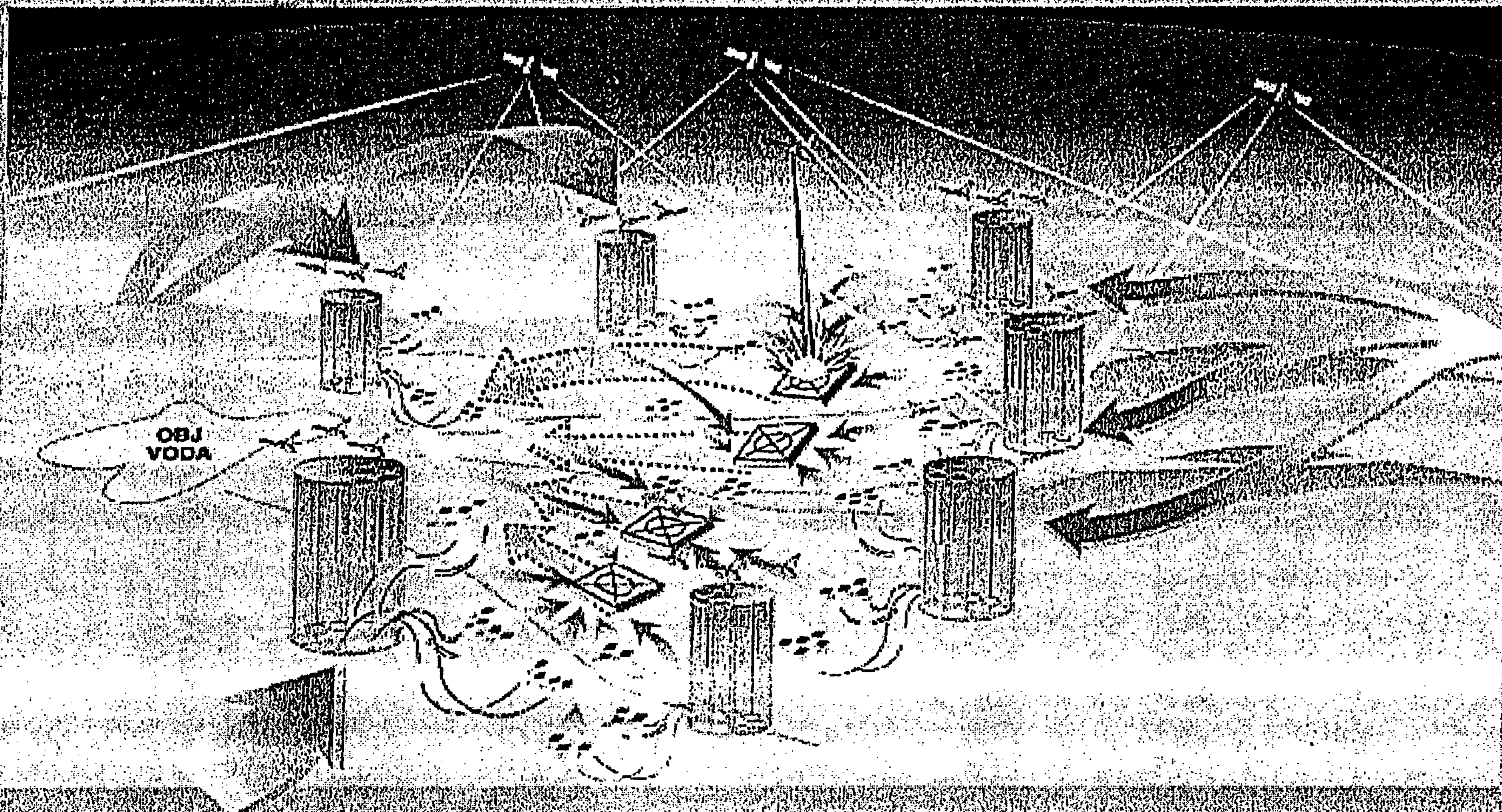


AAN - From Linear to Vertical C4I

Figure 16

Appendix A

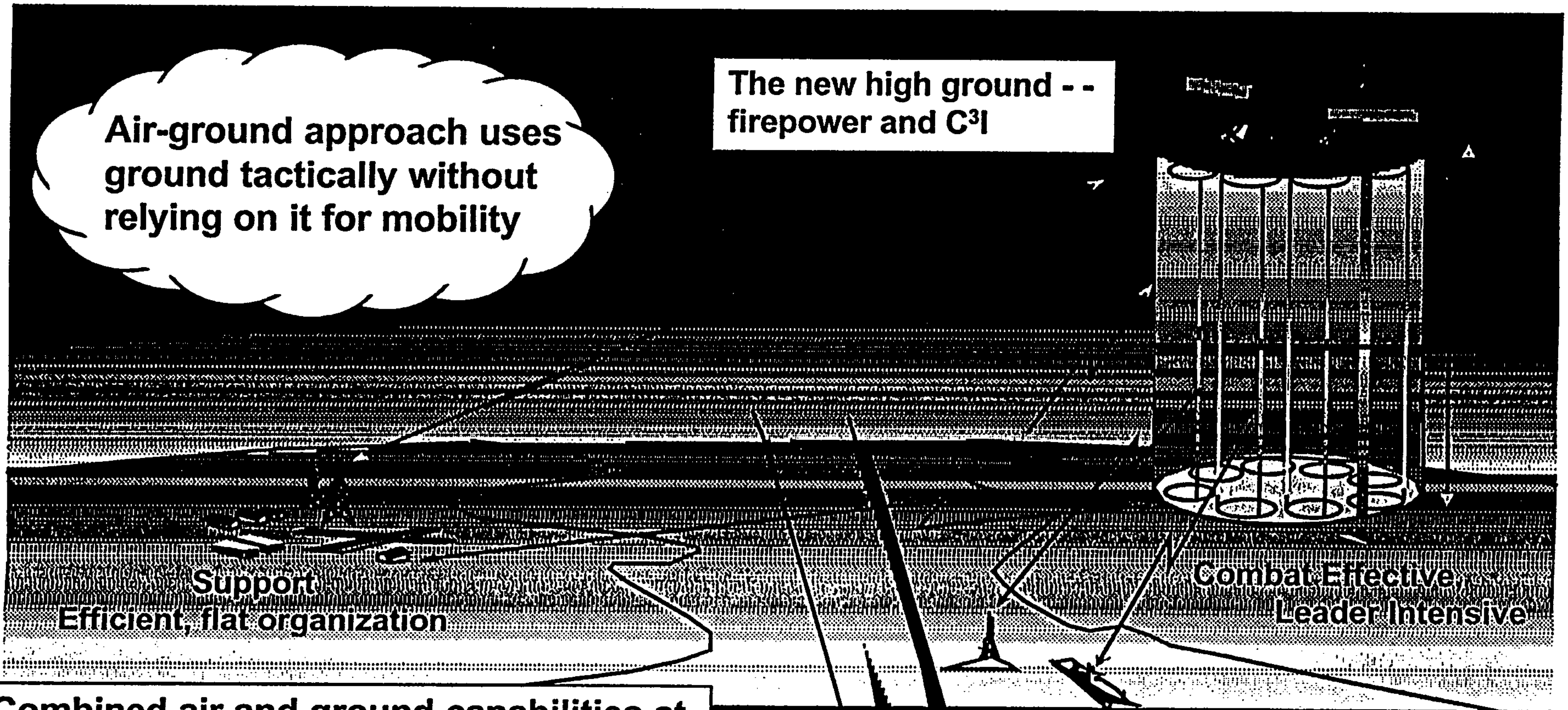
AIR-GROUND MANEUVER



Air-ground maneuver uses the ground tactically without relying on it for mobility. In the Leavenworth games, an AAN battle force was able to catch and defeat two moving enemy divisions in a remarkably short time.

Figure 17

OPERATIONAL CHARACTERISTICS of AAN (20XX)
. . . A BALANCED APPROACH to WARFARE



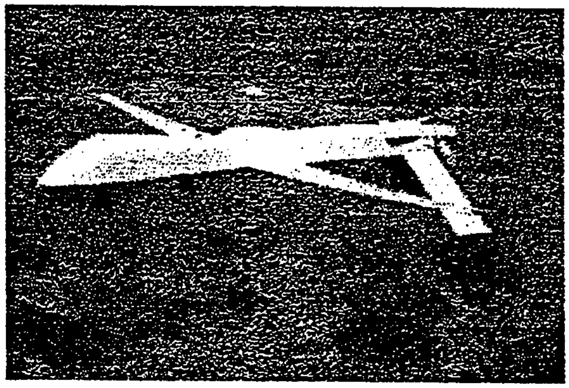
- Combined air and ground capabilities at lowest levels
- Independent operations for weeks
- All operating systems resident within battle force
- “Reach out” for combat functions (Fires, C^2, Logistics)

- Self-protection through movement, organic weapons, low-observables, and situational awareness
- Engage enemy with information, organic, and inorganic weapons
- Pull-Down Data – from the “Warehouse”

Operational Characteristics of AAN

Figure 18

Endurance UAVs

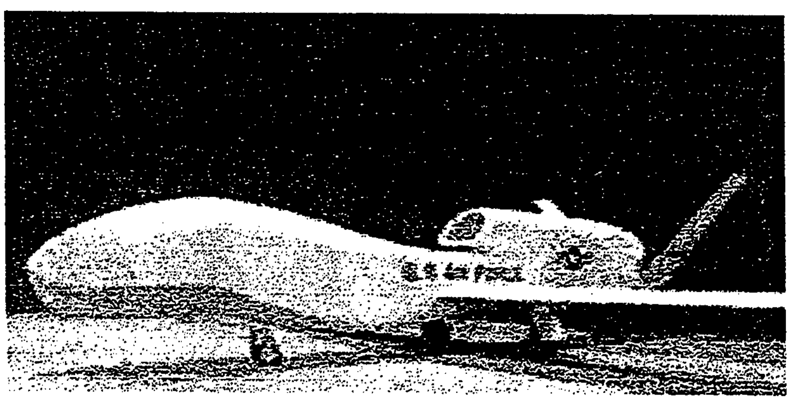


Predator (Tier 2) Medium Altitude Endurance

The General Atomic's Predator UAV has a 40 hour endurance, and a payload of up to 450 lbs internal. Additionally, there are two wing hard points that can carry up to 150 lbs apiece. Current payloads include an IR/EO sensor package and a Synthetic Aperture Radar (SAR) package. Powered by a Rotex 912 engine it cruises between 70 - 90 kts up to an altitude around 25,000 ft.

The Predator UAV went from first flight to combat operations over Bosnia in one year. The deployed Predators provided imagery to numerous customers in the Bosnian theater of operations. They have also taken part in several exercises in the U.S. The 11th Reconnaissance Squadron at Indian Springs, NV operates the Predator.

Back to top

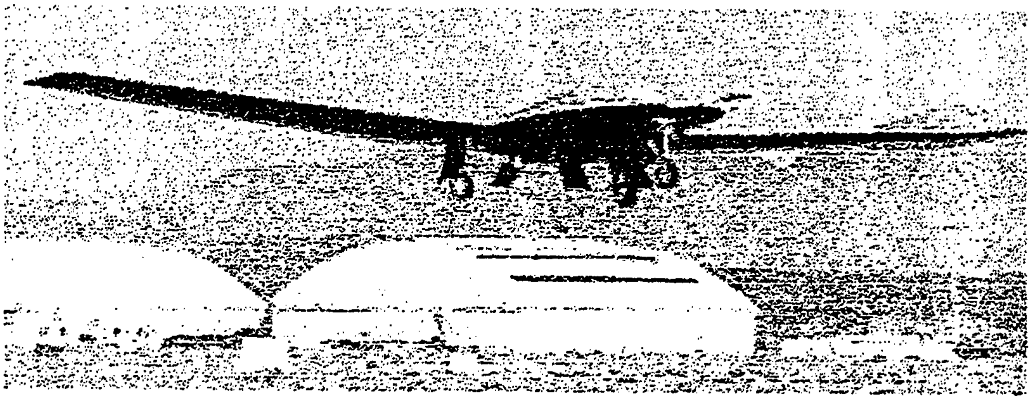


Global Hawk (Tier 2+) High Altitude Endurance

The Teledyne-Ryan Global Hawk is designed to be heavy-payload, long endurance, "work-horse" UAV. It is slated to have a range of 3000nm with 24 hrs of loiter time at that range (greater than 40 hrs at closer ranges), and an altitude up to 65,000 ft. Current payload plans are for SAR, EO and IR sensor packages. With line of sight (LOS) and satellite communication (SATCOM) links it will provide near-real-time imagery to friendly forces.

The first Global Hawk had a roll-out ceremony in February 1997. Initial flight testing will follow.

Back to top



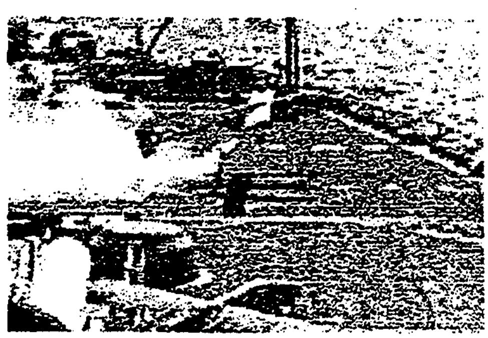
Darkstar (Tier 3-) Low Observable (LO) High Altitude Endurance

Lockheed-Martin and Boeing are the prime contractors for the Darkstar. Still in the flight test phase it is slated to have over 8 hours endurance at a range greater than 500nm. Like the Global Hawk it too will have LOS and SATCOM links, and carry either an EO or SAR payload to gather imagery. The LO characteristics should make the Darkstar survivable for long periods over the battlefield.

Flight testing should resume by summer 1997 following the crash of one Darkstar on its second flight.

Back to top

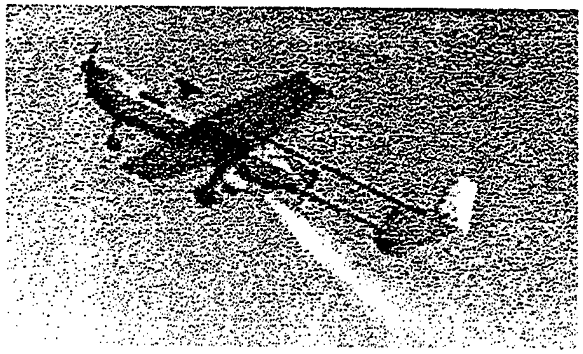
Tactical UAVs



Pioneer

The Pioneer is a short range tactical UAV that saw combat in Desert Storm. It has 5 hour endurance carrying an EO/IR sensor package. Range is near 100nm with a max altitude around 15,000 ft. This UAV is primarily used for battlefield surveillance and both field and naval artillery spotting.

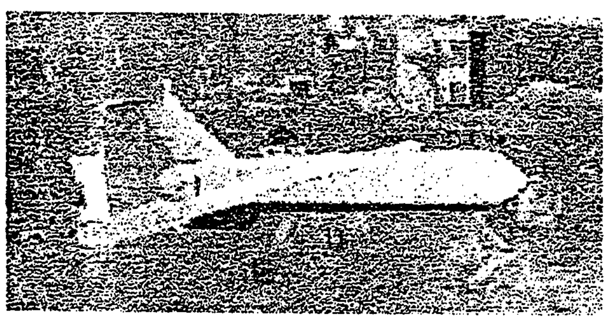
Back to top



Hunter

The Hunter Short Range UAV is a TRW product. It has a 12 hour endurance carrying an EO/IR sensor package. Its twin 750cc motors allow for a cruise of 70 kts, a range near 100nm, and an altitude of around 15,000 ft. It uses GPS navigation and LOS communication. This UAV is also primarily used for battlefield surveillance ("who's behind the hill") and field and naval artillery spotting.

Back to top

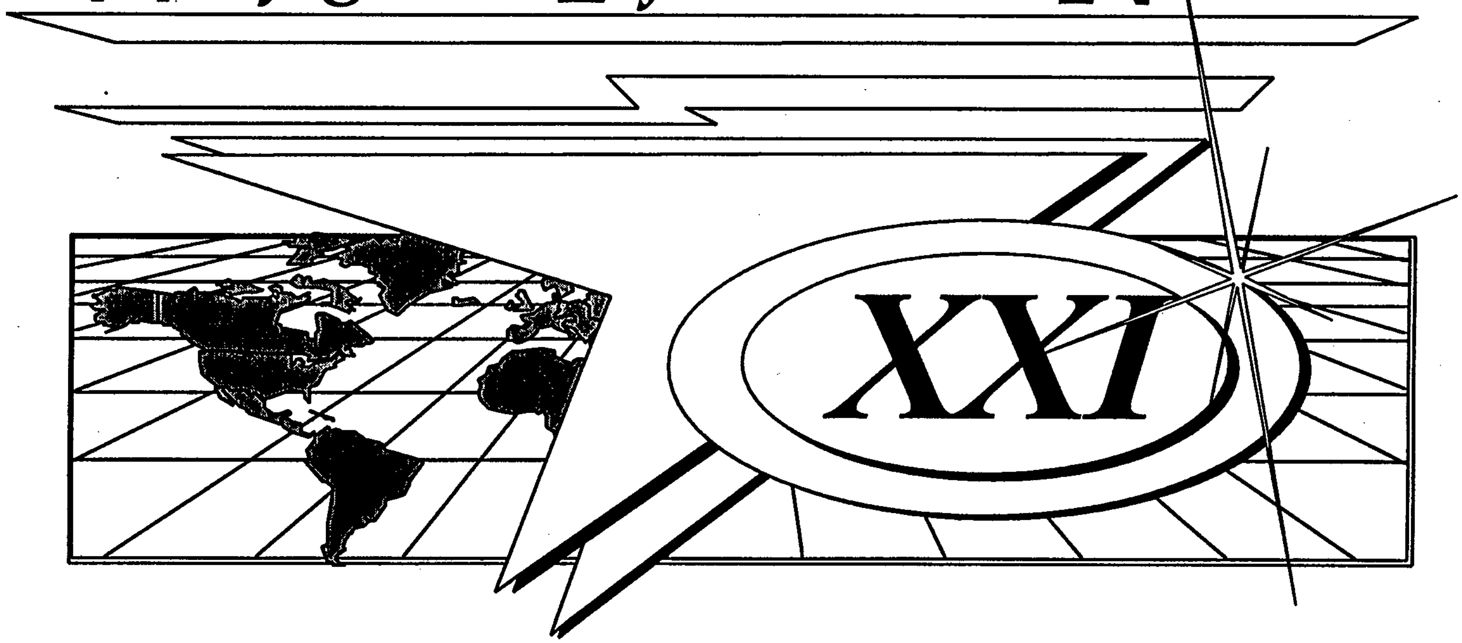


Outrider - Joint Tactical UAV

The Outrider by Alliant Techsystems will be the newest of the short range UAVs. It is expected to have an endurance of nearly 5 hours, a range of 120nm, and an operational altitude of 15,000 ft. It is equipped with GPS and uses LOS communication. The first one is scheduled to arrive at Fort Huachuca in April 1997.

Back to top

Warfighter Information Network



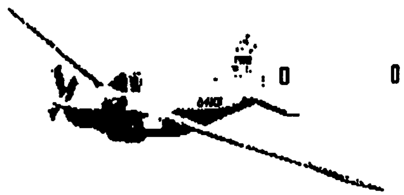
Airborne Communications Node
"(ACN)"

ROD 19 Sept 96

Airborne Communications Experiments - Background

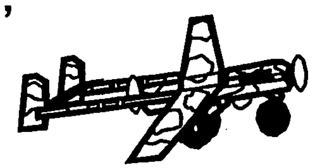
- 1992....Balloon (3,500 ft.) - RT-460, SINCGARS

- 1993....JWID - Egrett (49,000 ft.) - SINCGARS, RT-460: relayed signals from Fort Bragg to Fort Gordon, demonstrated UHF on-the-move



- 1995....JWID - Egrett (17,000 ft.) - MSE Range Extension Relay (Band I):
  17,000 ft. - two 256 Kbps DTGs established for 120 mile total distance
  17,900 ft.- mobile RAU and SEN linked maintained at 60 miles to platform

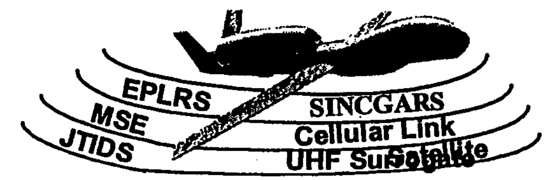
- 1996....Hunter UAV CRP (10,000 ft.) - UHF Surrogate Satellite, SINCGARS Relay: Connected ground stations separated 120 miles

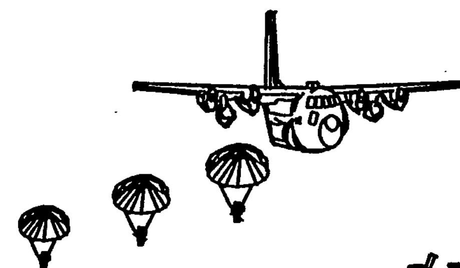


Airborne Communications Node Definition

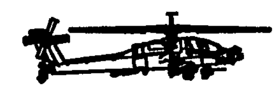
ACN is a revolutionary aerial communications platform that supports the Warfighter Information Network *(WIN)* and Joint Task Force with:

- *Over the Horizon Communications*
- *Reachback Connectivity,*
- *Communications On the Move*
- *Gateways for Seamless Communications during:*

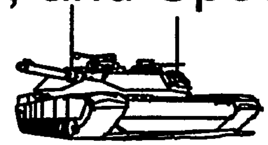




- Opposed and Unopposed Entries
- Corps and Division Offensive Operations



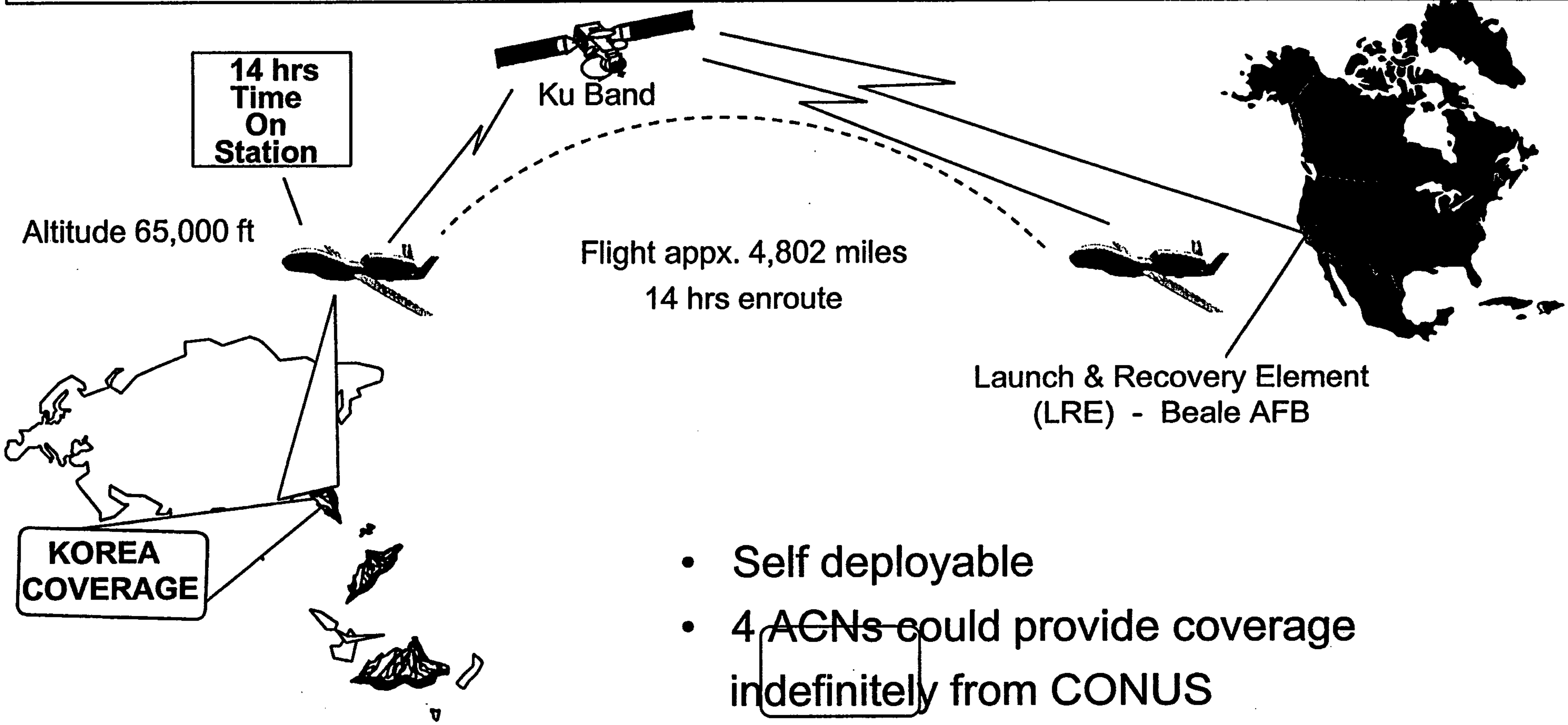
- Aviation, Armored, Infantry, and Special Operations Deep Attacks
- ACR Screening Missions



- Theater Communications Support (Joint)

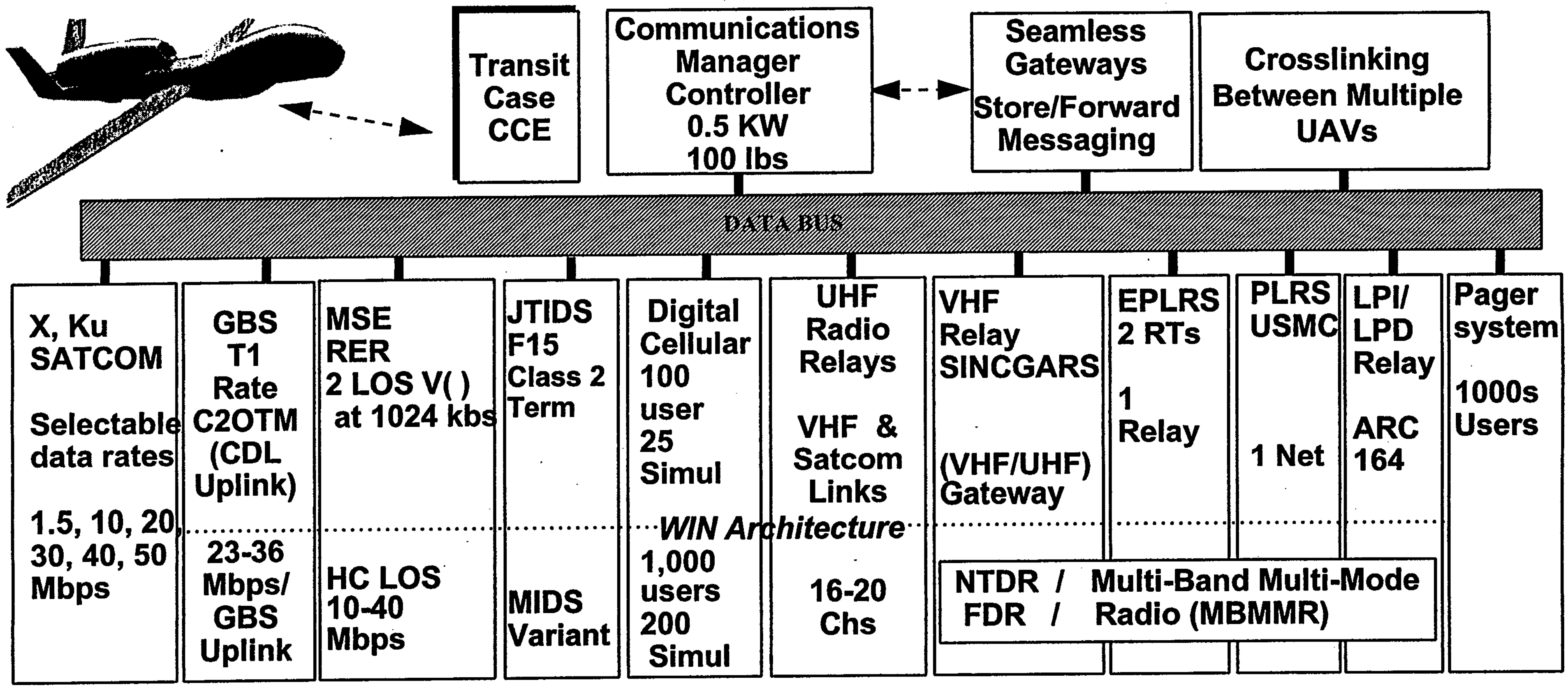
- Disaster Relief, Humanitarian Assistance, and Stability Operations

Global Hawk ACN Mission Profile NEA MRC



- Self deployable
- 4 ~~ACNs~~ could provide coverage indefinitely from CONUS
- 28 hours flight to/from objective
- 14 hours time on station
- 4 hours ground maintenance

Global Hawk ACN Objective Comms Capabilities

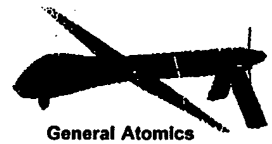
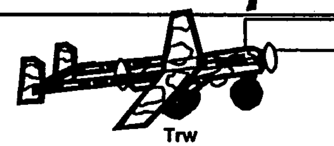


Provides Robust Gateway/Waveform Transformation, Bridging, Routing, Relay/Range Extension, Multimedia Services, Communications On The Move, Theater-Wide Broadcast/Paging Including Broadcast of Wideband Data to Terminals-on-the-Move and Handheld Communications

- **Green: Initial Capability**
- **Blue: Future Growth Capability**

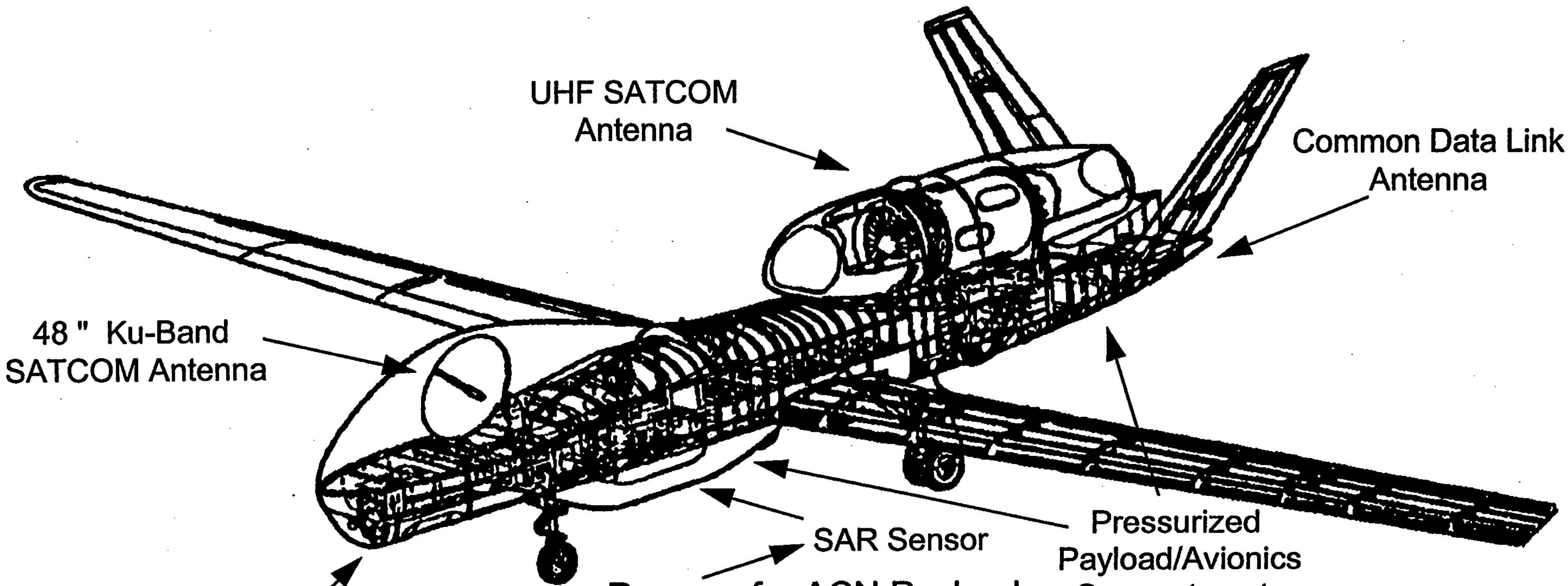
CCE - Communications Control Element

UAV Communications Platforms Comparison

	 Teledyne Ryan Aeronautical ACTD 1998 / 1999 **HAE UAV Tier II + "Global Hawk"**	 General Atomics **MAE Tier II "Predator"**	 Trw **"Hunter"**	 Alliant Tech **Tactical UAV "Outrider"**
PAYLOAD	Tactical C3; EO/IR, SAR; TMD	EO/IR or SAR	Day/night TV and FLIR	EO/IR
DEPLOYABILITY	Self Deployable Worldwide	Not Self Deployable	Not Self Deployable	Not Self Deployable
ENDURANCE	42 Hours	40+ Hours	8-12 Hours	3 Hours
RANGE	3000 nm/24 hrs/3000 nm	500 nm	200 Km	100-125 nm
LOITER ALTITUDE	65,000 ft (above commercial airspace)	25,000 (in commercial airspace)	15,000 ft (in commercial airspace)	13,000 ft (in commercial airspace)
COMMUNICATIONS FOOTPRINT	300 - 400 mile diameter	195mile diameter	100-150 mile diameter	95 mile diameter
PAYLOAD CAPACITY	2,000 lbs	450 lbs	200 lbs	80 lbs
FLIGHT CRITICAL RELIABILITY	1 loss in 200	?	?	?
AIR VEHICLE PROGRAM QTY	2 initial ACTD	66 planned to purchase	?	?
SURVIVABILITY	threat warning limited ECM	within enemy air defense	within enemy air defense	within enemy air defense

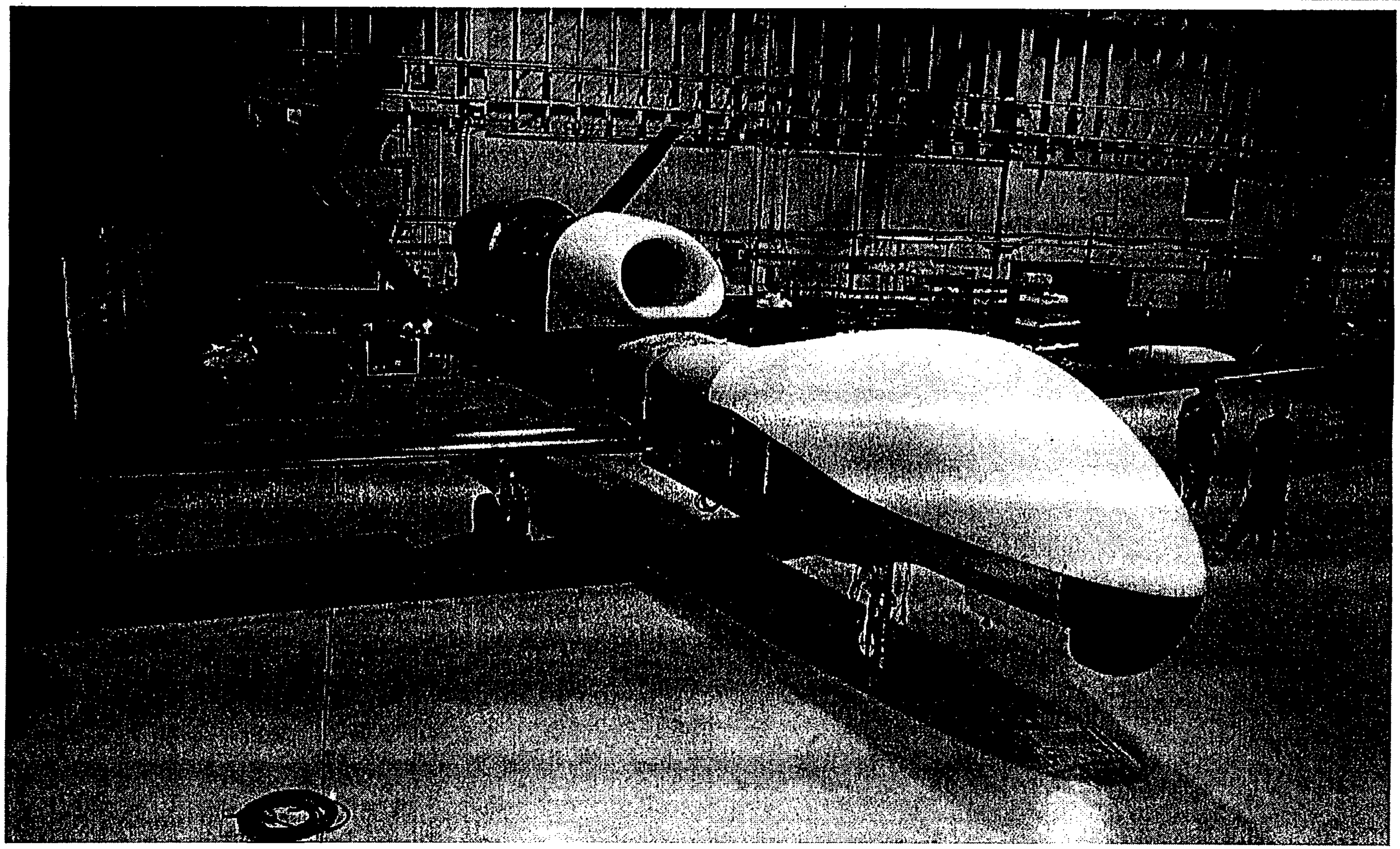
Bottom Line: Global Hawk is optimum platform for tactical C3 !!!

"Global Hawk" Performance and Specifications

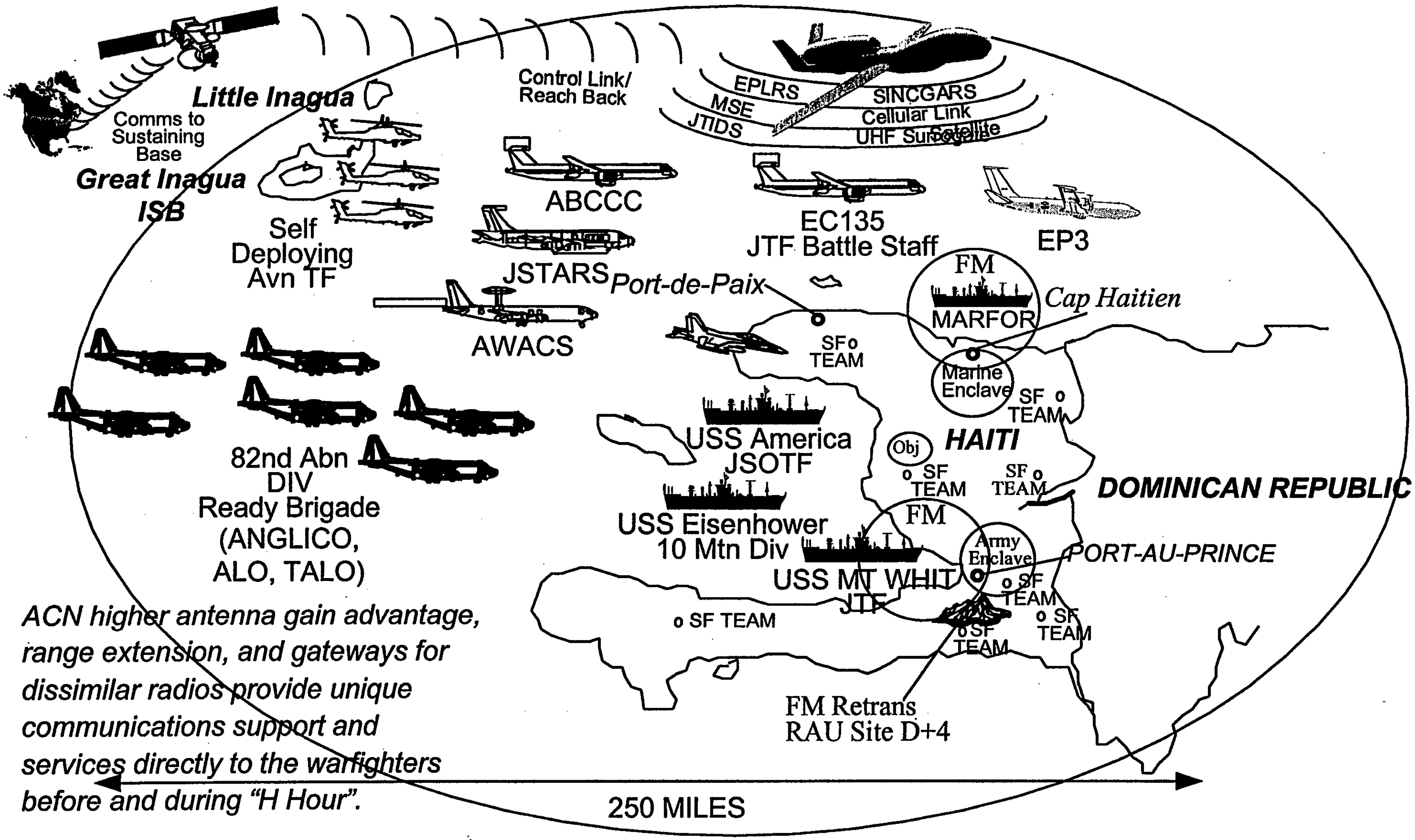


Maximum Radius	3000 NM/24hr/3000NM	Fuselage		Weights:	
Maximum Altitude	67,300 Ft	Width	4.8 Ft	Structure	3,920 Lbs
Loiter Time	42 Hrs	Length	44.4 Ft	Empty (incl fluids)	7,648 Lbs
Loiter Velocity	343 Kts	Wing		Payload	2,140 Lbs
Ferry Range	14,405 NM	Area	540 Sq Ft	Take-off-fuel	14,210 Lbs
Flight Critical Reliability	1 Loss in 200 (objective)	Span	116.2 Ft	Take-off-gross	24,000 Lbs
WB SATCOM	50 Mbps	Engine	AE3007H		

Global Hawk - Oct 96



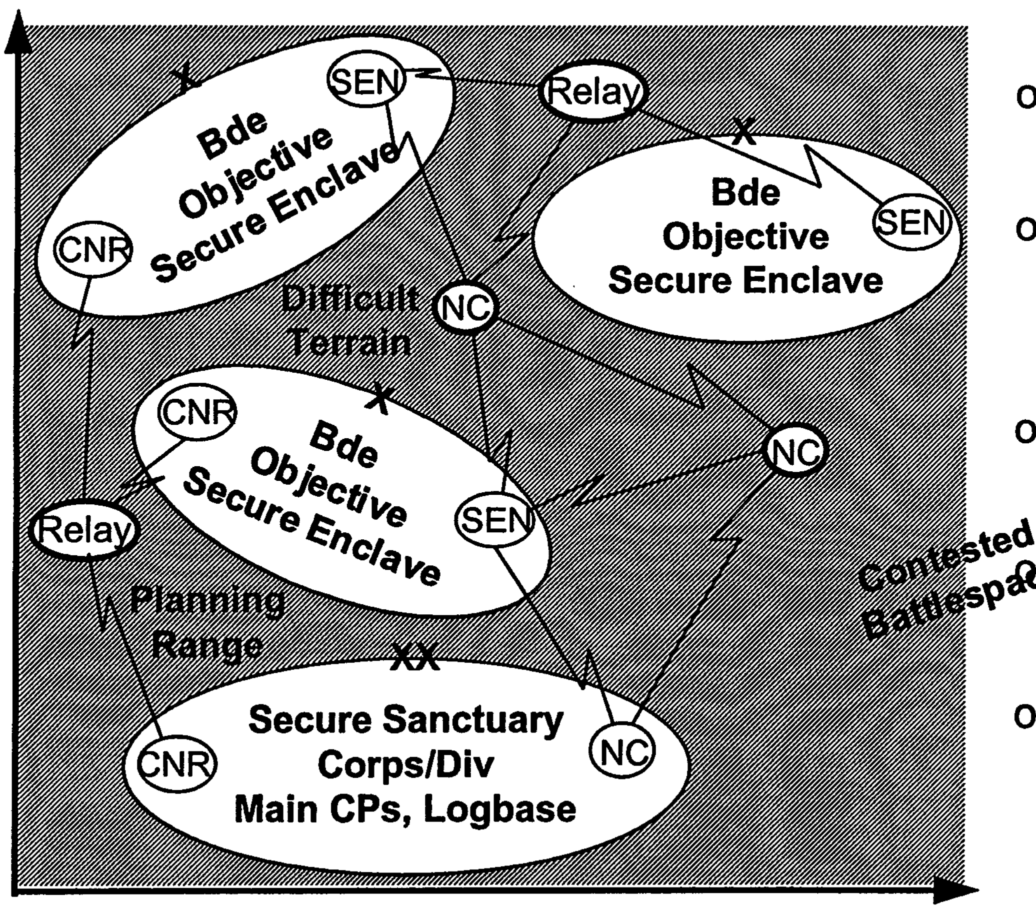
ACN Coverage - Haiti Scenario (Joint Task Force Support)



ACN higher antenna gain advantage, range extension, and gateways for dissimilar radios provide unique communications support and services directly to the warfighters before and during "H Hour".

Force XXI - ACN Required For Connectivity

CORPS AREA OF OPERATIONS



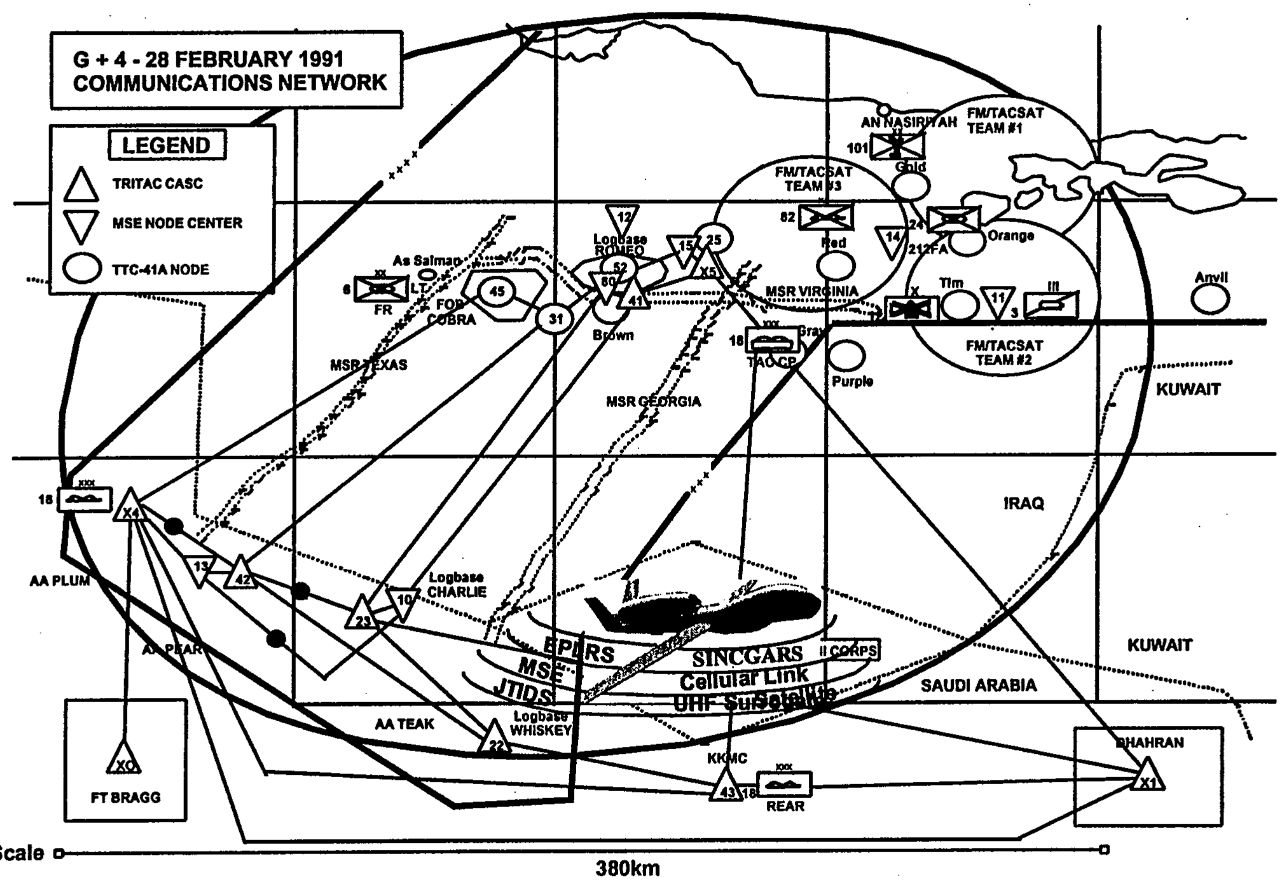
New Nonlinear Force Projection Offensive

- o ACN on station at H Hour to support earliest entering forces.
- o ACN provides range extension while terrestrial relays are being established.
- o If you lose a UAV, you only lose equipment, not lives.
- o Augments but does not replace satellite connectivity.
- o Provides range extension for the tactical internet (FDR, SINCGARS SIP, EPLRS, and HCTR).

DIGITIZATION INCREASES REQUIREMENTS FOR THROUGHPUT AND BEYOND LINE OF SITE CONNECTIVITY.

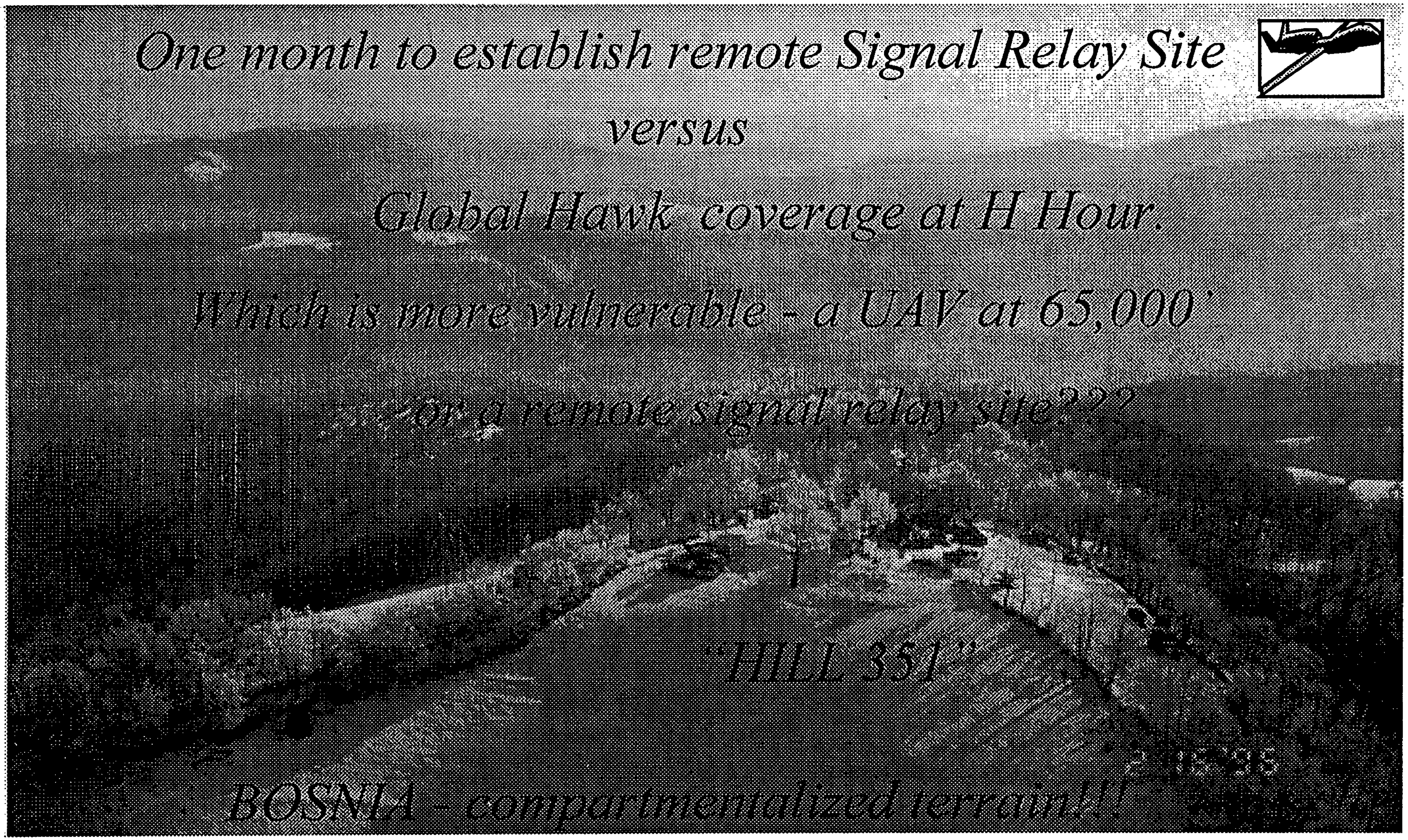
Global Hawk ACN Coverage For Desert Storm Scenario

ACN comms footprint provides the Corps Cdr with direct access to Div Cdrs on SINCGARS C2 net (without the need for VHF-UHF to UHF-VHF gateways).



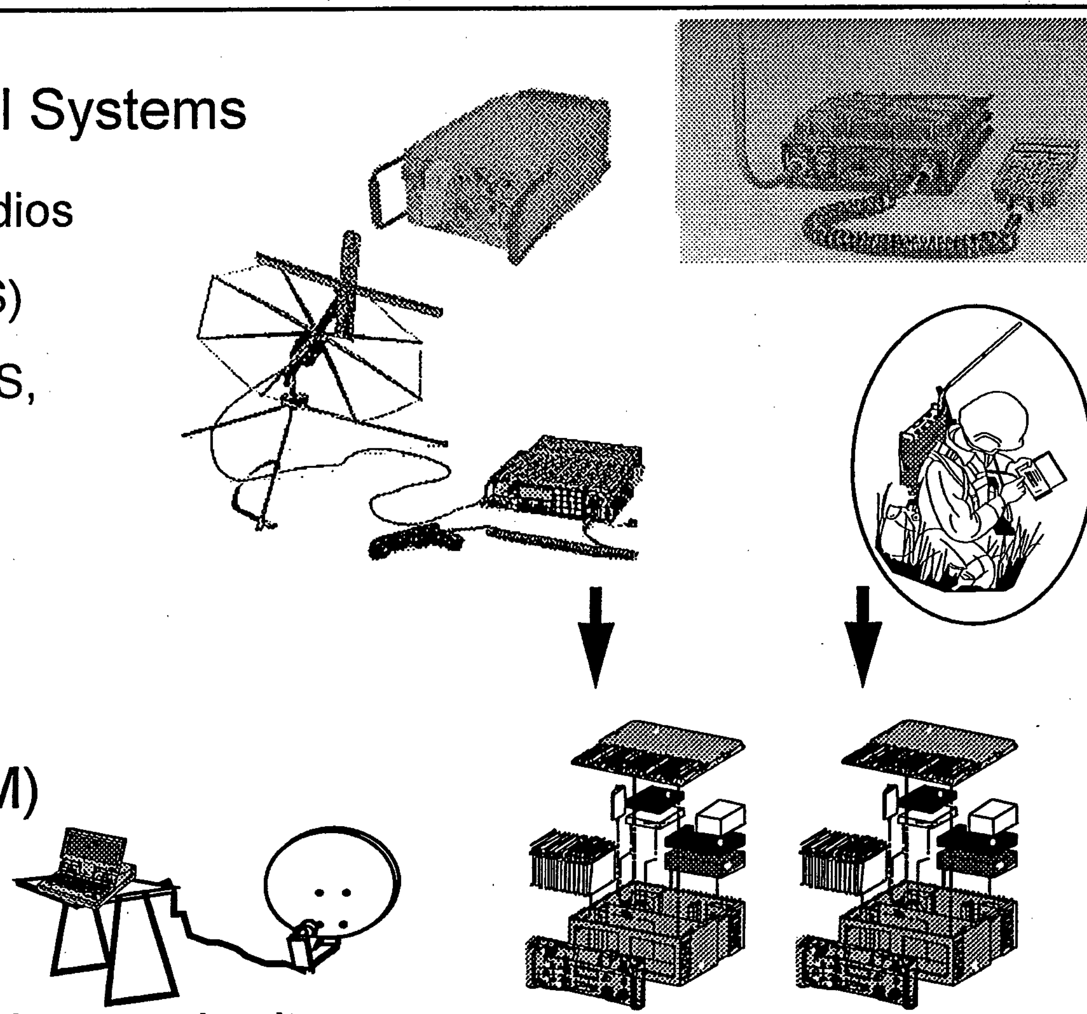
"One ACN could provide coverage for an entire corps sector"

Global Hawk Overflight Zones in Bosnia - Notional



Global Hawk ACN Equipment

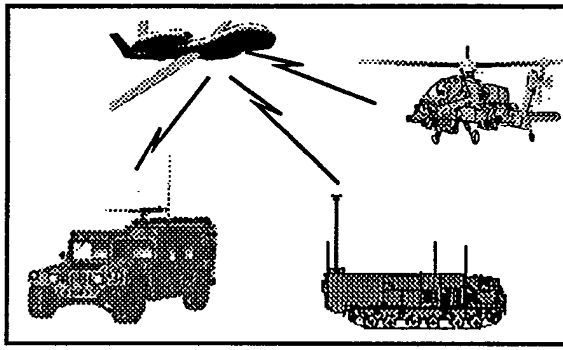
- Range Extension Terrestrial Systems
  - High Capacity Line of Sight Radios
  - Tactical Internet (EPLRS, PLRS)
  - Combat Net Radios (SINCGARS, FDR, UHF TACSAT)
  - Joint Tactical Information Distribution System (JTIDS)
  - LPI/LPD Radios
- UHF C2 On-The-Move (OTM)
- Communications Manager
  - OTAR
  - Reconfigure payload with portable ground unit



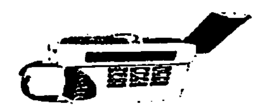
Multi-Band Multi-Mode Radios

Global Hawk ACN Equipment - New Services

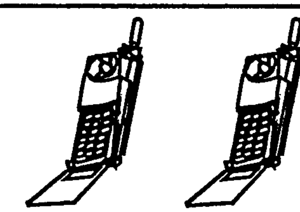
- GBS Rebroadcast to Forces On-the-Move
  - T1 Broadcast to Omni-Antennas
  - Requires 50 Watt Transmitter at 1.5 GHz
  - Uplink by CDL or Ku SATCOM
- Theater Paging System
  - Can Provide NBC or TBM Attack Warning
  - Requires 30 Watt Transmitter at 850 MHz
  - Uses Commercial Paging Receivers
- Handheld Radio System Leverages COTS Cellular/LEOSAT Technology
  - Small, Inexpensive Handsets for Secure Voice/Data
  - Requires High-Capacity Base Station
  - Requires Robust Antenna for Long Range and for Interference Rejection
- Communications Gateways Among Dissimilar Radios



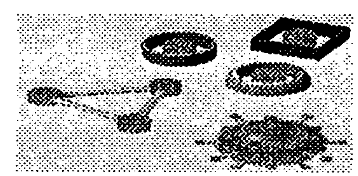
Battlefield Paging



COTS Handsets

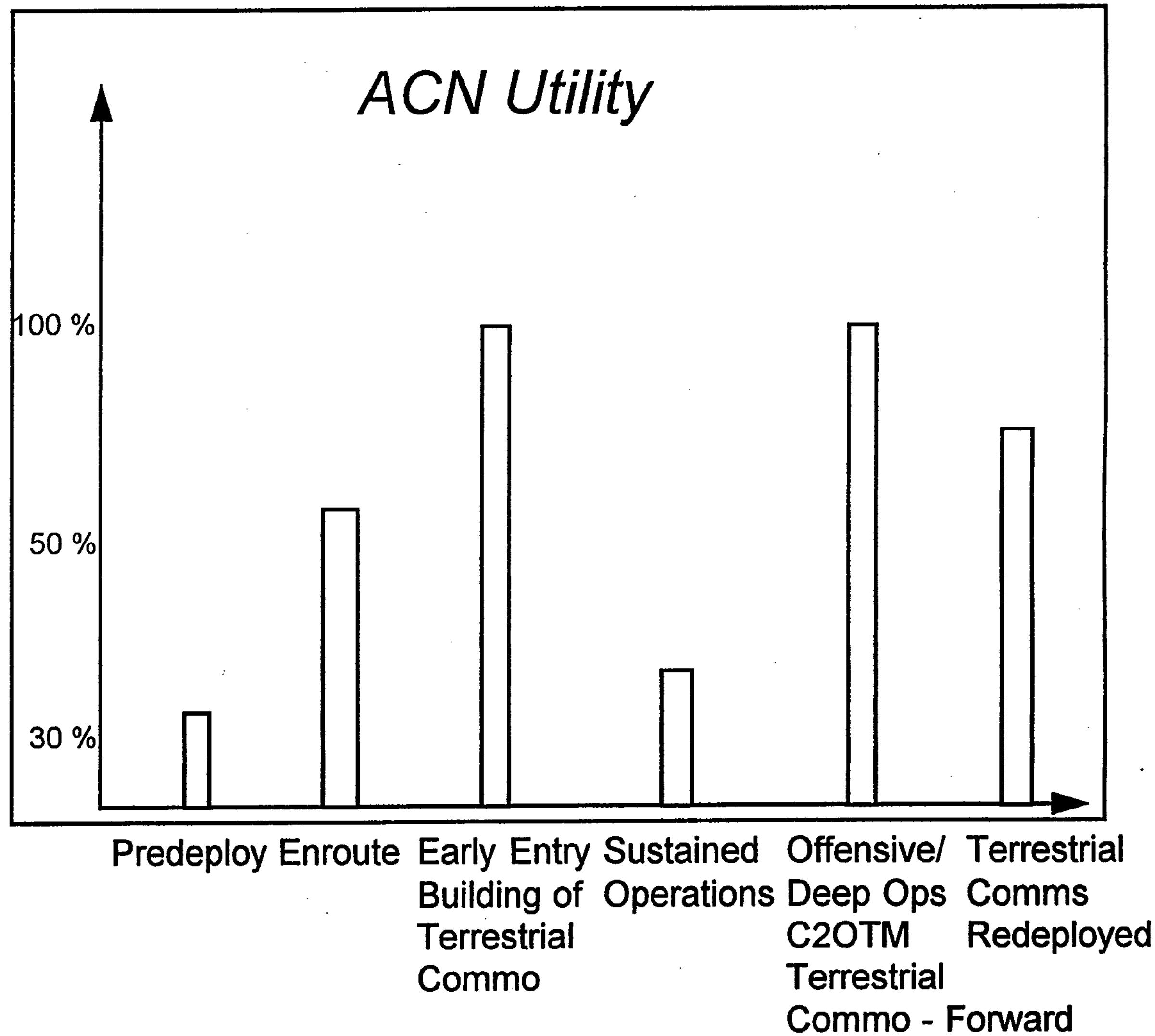


Gateways

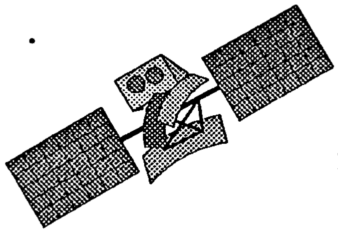


ACN Role Tied to Contingency Phases

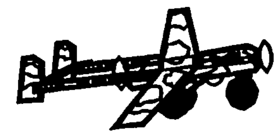
- Pre-Hostility Phase
  - Only SOF and Reconnaissance Elements Present
- Enroute and Early Entry Phase
  - Arrival and Insertion of Ground Forces Ashore
  - Establishment of CJTF Ashore
  - Greatest Strategic Lift
  - Most Austere C4I Environment
- Sustained Operations
  - Defensive Operations
  - Consolidation and Expansion of Enclaves
- Deep/Offensive Operations
  - Rapid Maneuvers
  - Range Extensions
- Redeployment
  - Departure of Combatants



ACN Related Studies



DSC Summer Study Report (1997) SATCOM/UAV

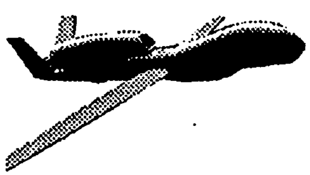


- Final Report :

a. Tactical Air / ground Warfighters : UAV's are more cost effective as a gateway and relay extension (Commercial PCS for 800 users with MILSATCOM $ 648M vs UAV $ 177M).

b. For a Theater of Operations : Unmanned Aerial Vehicles are moderately cost effective and can provide a significant benefit to the Warfighters during a Major Theater War. (Commercial without radio relay and MILSATCOM $ 132M+ vs UAV $ 177M).

c. For Strategic Operations : Unmanned Aerial Vehicles have limited roles and their use over a prolonged time period will not be cost effective. (Commercial and MILSATCOM $33M vs UAV $177).

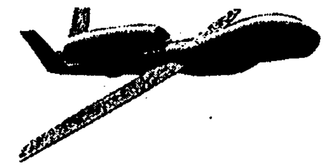


America's Army

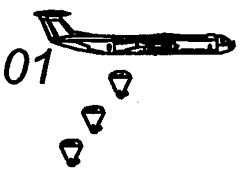
Where We're At

ABCCC

MARFOR



- *TRADOC DCSCD: Sept 94 memo stated comms as 1st prority on Global Hawk*



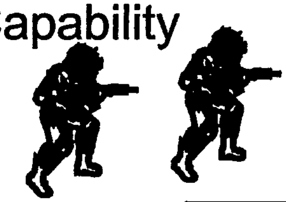
- *DARPA ACN 5 year program : $ 8.4M for FY97 and $ 68M thru Fy 01 (develop initial capability)*

- *Army ORD (Annex H) for E-UAV (approved by TRADOC on 27 Jun 96) and sent for inclusion in Air Force ORD in April 97.*

- *USACOM In second year of a five year program to develop the Con-Ops for the Dark Star/Global Hawk.*

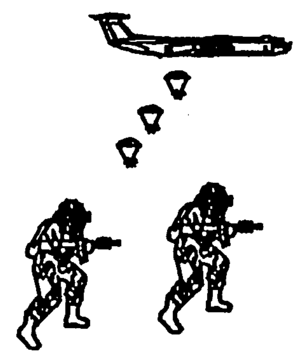
- Soliciting *JROC support for ACN ACTD.* Must work through ACTD process for proposal acceptance and brief ACN Concept to Joint Warfighting Capability Assessment (JWCA) team for assessment and comment

NAVFOR

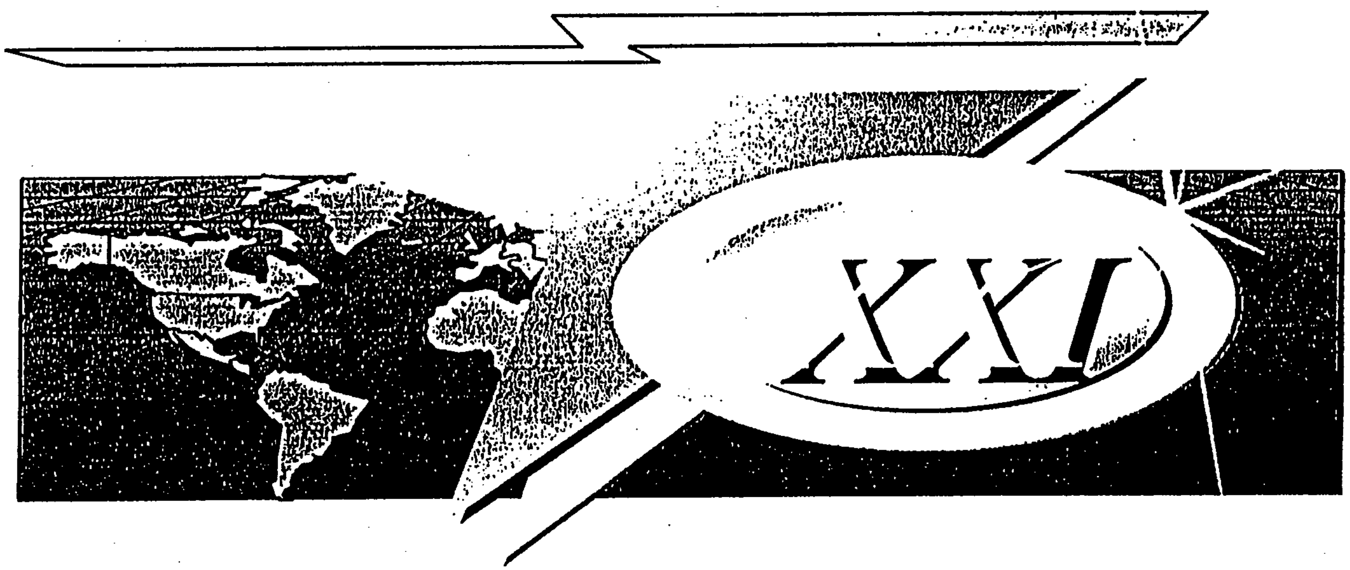


Key Things We Must Do!

- ☑ *Continue DARPA ACN program (services supported).*
- ☑ *Continue to work closely with Air Force so that ACN is top priority in their ORD.*
- ☑ Get *JROC support for ACN. ACN added to priority list and funded for future ACN ACTD.*
- ☑ *Work with USACOM to sponsor ACN ACTD and complete management plan.*



Warfighter Information Network



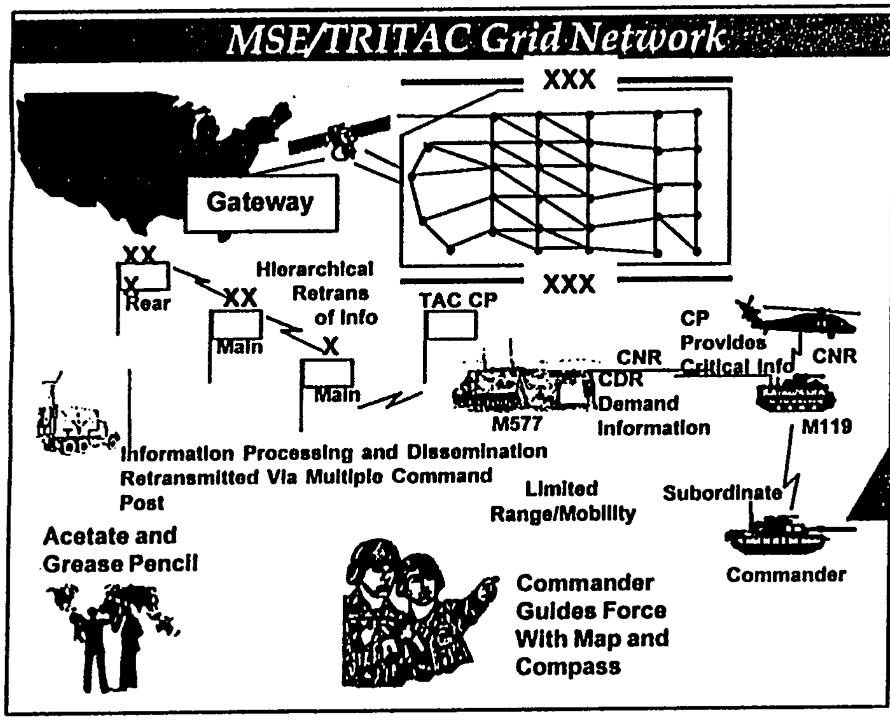
Overview
17 October 1997

United States Army Signal Center

The Digitized Battlefield

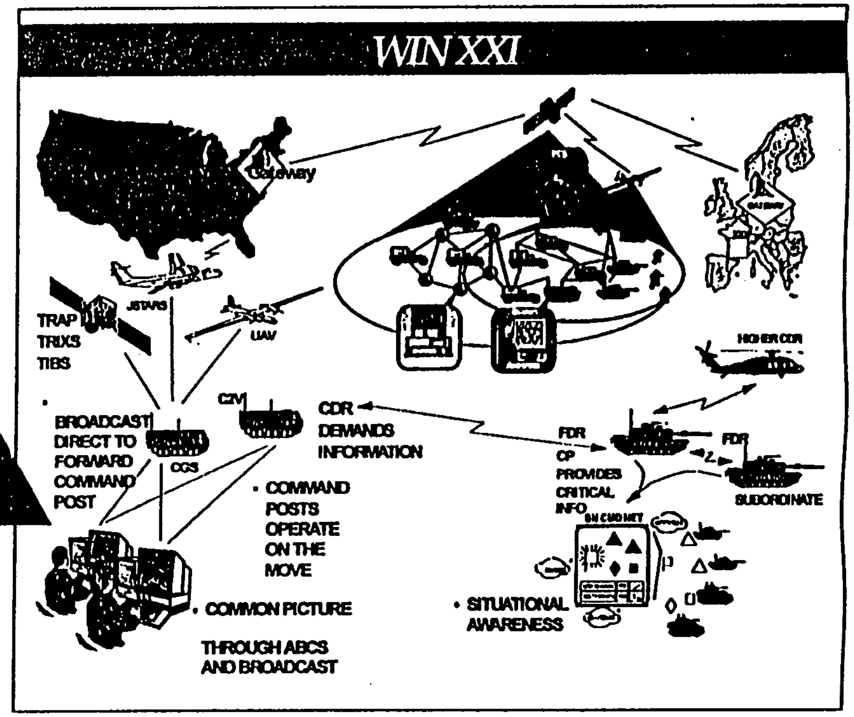
- Signal Corps Has a Force Modernization Vision for the Future... Warfighter Information Network (WIN)
- This Briefing Explains WIN and Provides a Current Status of Key WIN Programs

MSE/TRITAC Grid Network



We
Are
Here

WIN XXI



Information Technology Revolution

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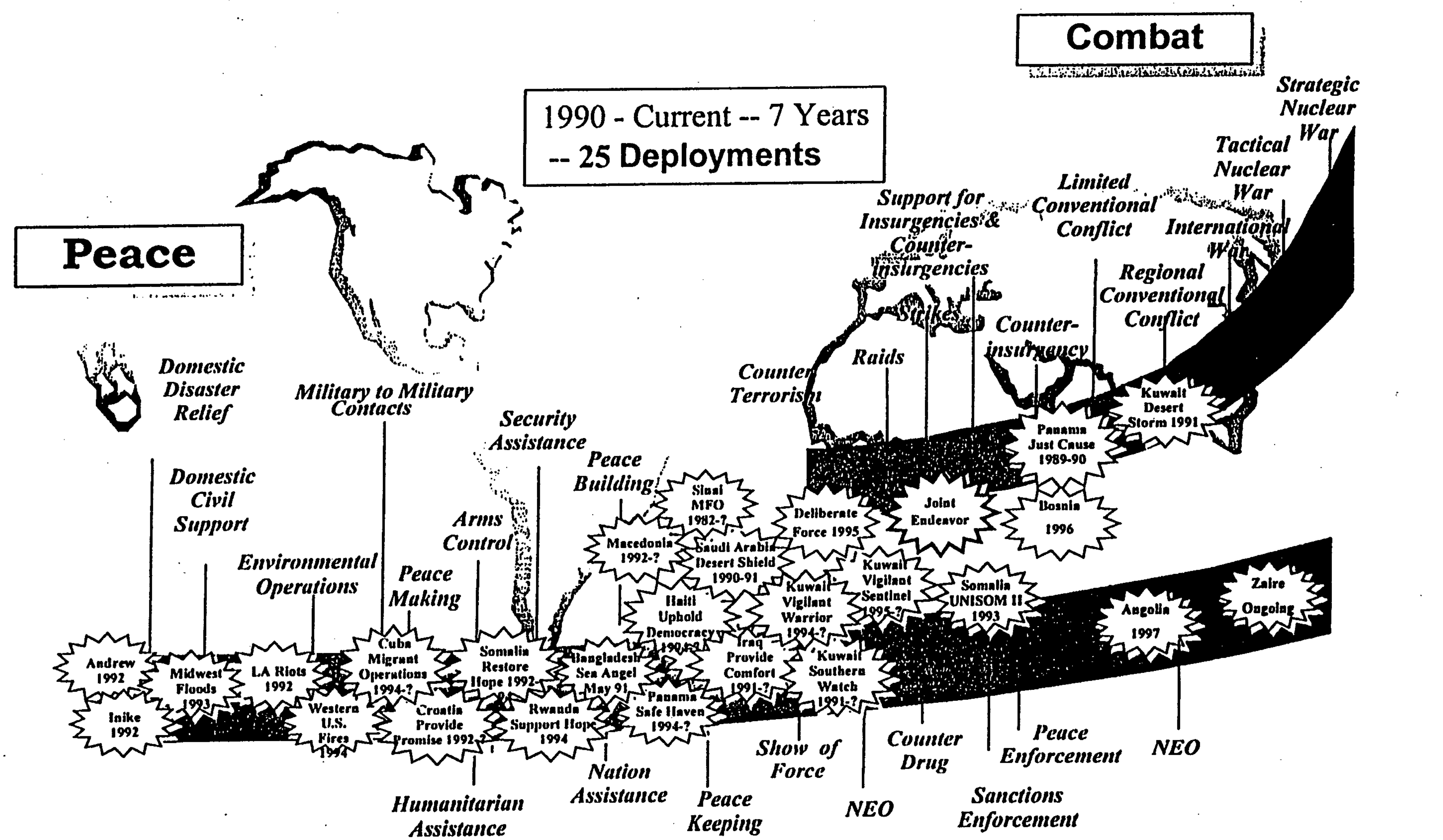
Mission Changes & Operations Tempo



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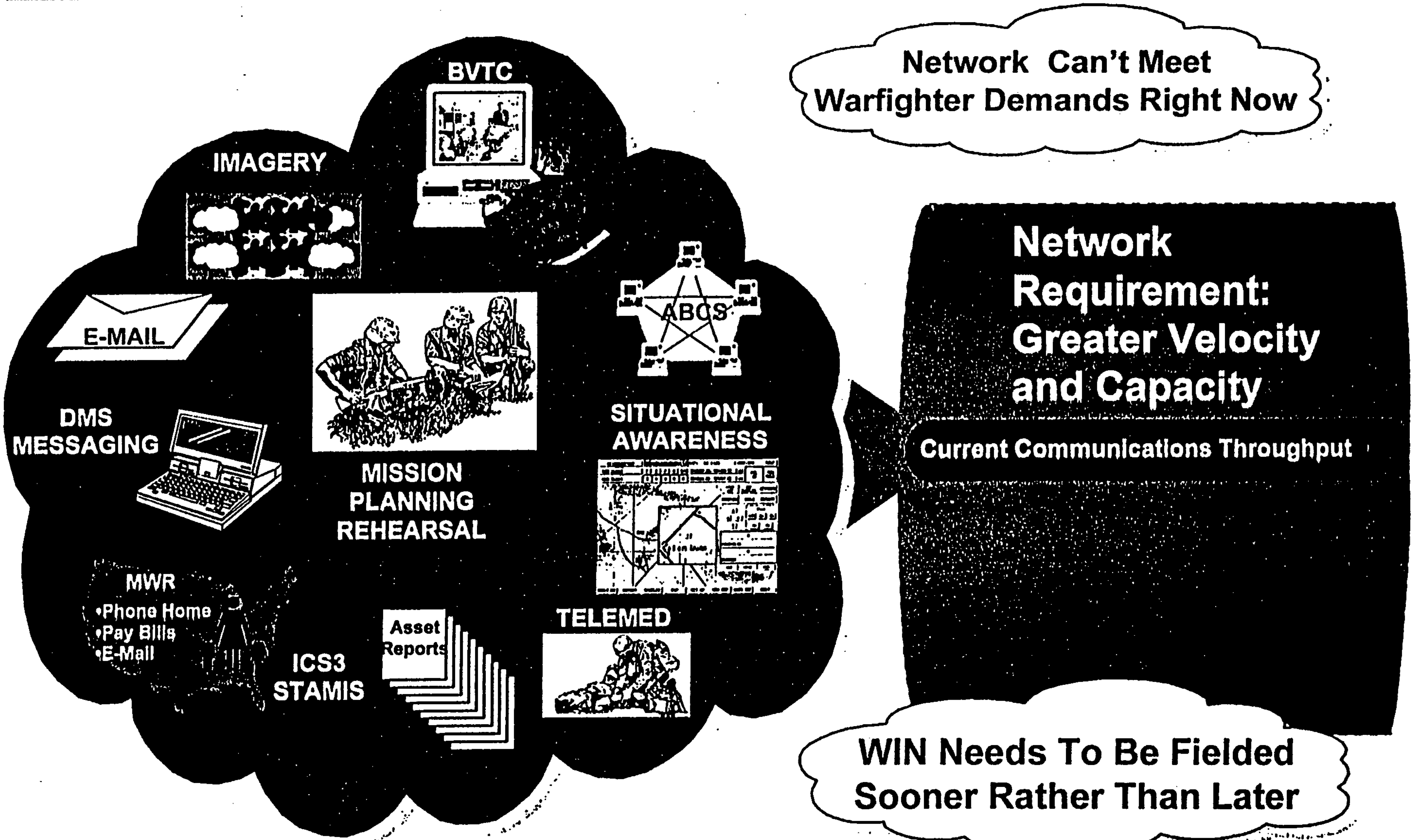
Warfighter Requirements vs. Network Capacity



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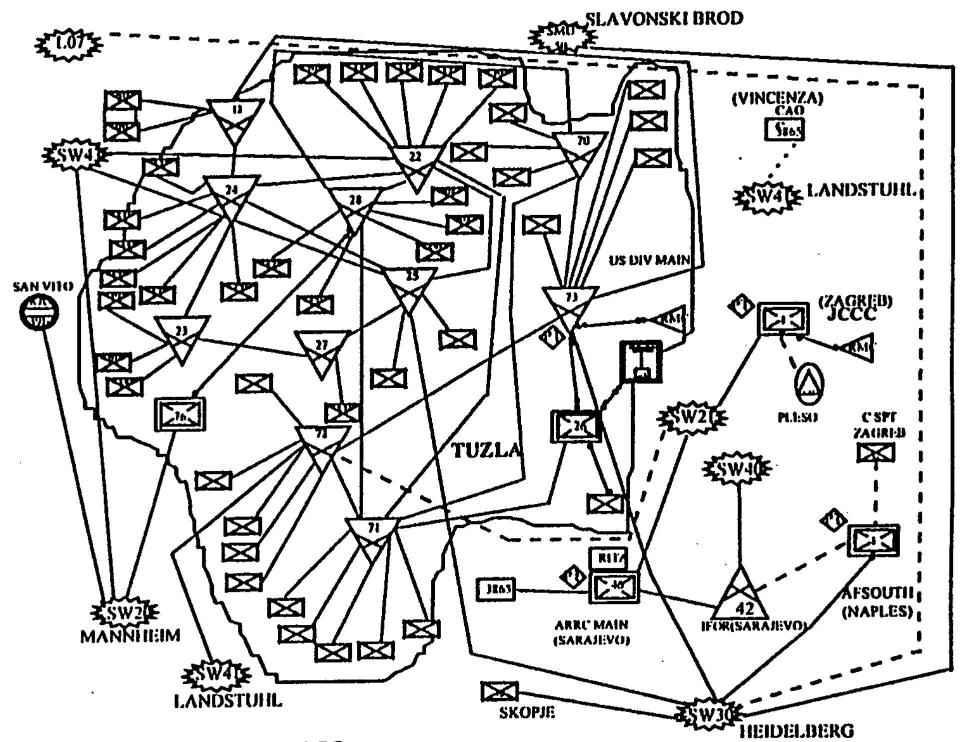
Task Force Eagle (1AD) Signal Support

1AD Division
- 4 Node Centers
- 18 SENS = CPS
- 0 Multichannel SATCOM
- D-Main 350 Personnel
- 1300 Telephones (Entire Div)
- Secret High Only - Tactical Packet Network

TF Eagle / MND North
- 11 Node Centers
- 41 SENS = CPS
- 12 Multichannel SATCOM
- D-Main 1100 Personnel
- 1770 Telephones Within TF
- 16 E-Mail Hosts
- 2100 E-Mail Users
- VTC to BDE CBT Tms
- LANs @ All BNs
- Data Connectivity Down to Company Level
- Point of Presence Routers
- NES on TPN
- Global Broadcast Service
- 24Mbs Commercial Augmentation

"Units Are Not Operational Until They Are Connected"
"OJE Is the Age Of E-Mail"
LTG Abrams, V Corps, CDR



Magnitude of Difference
Signal Personnel: 1AD - 520 / **TF Eagle 2675**

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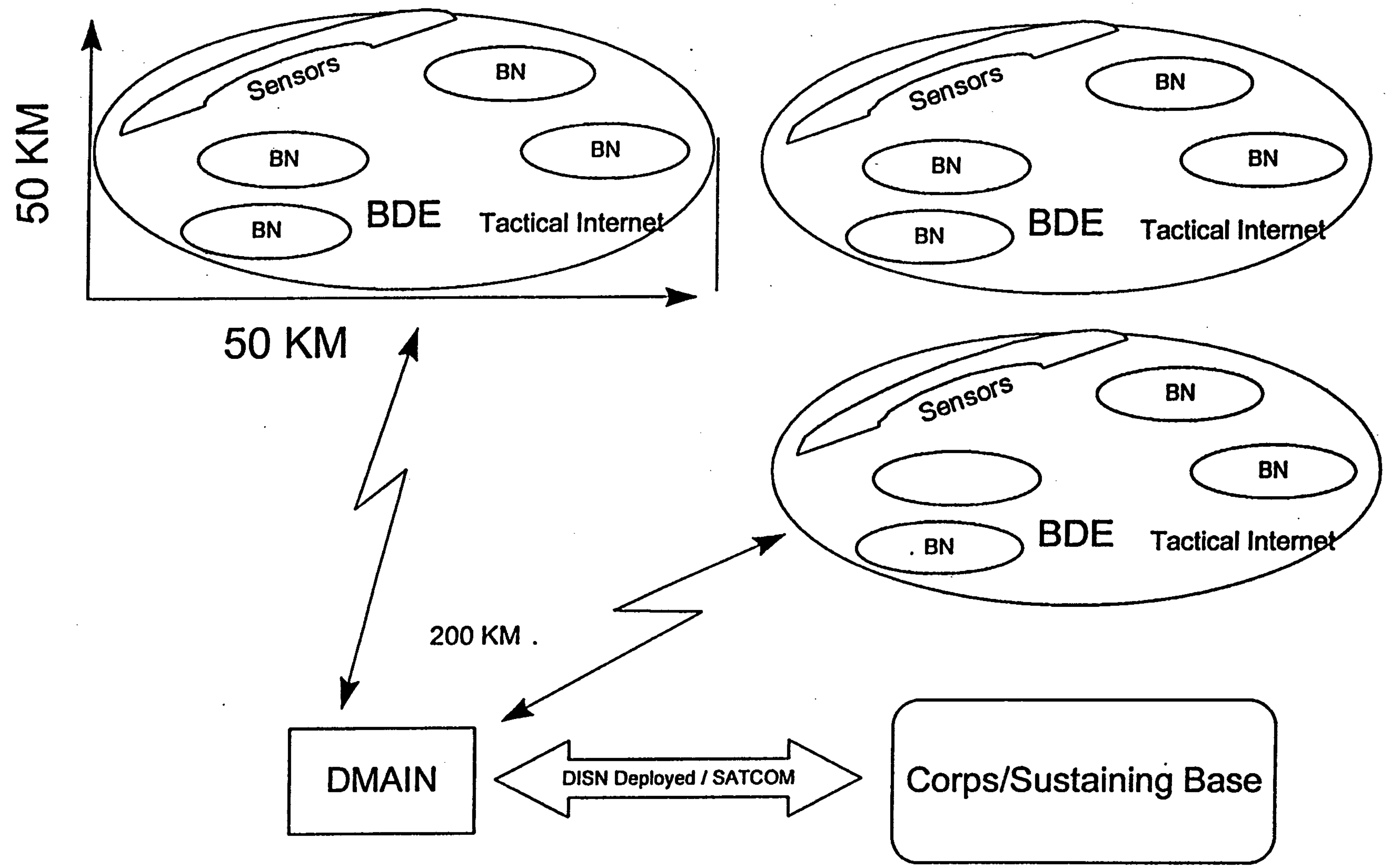
Future Battlespace



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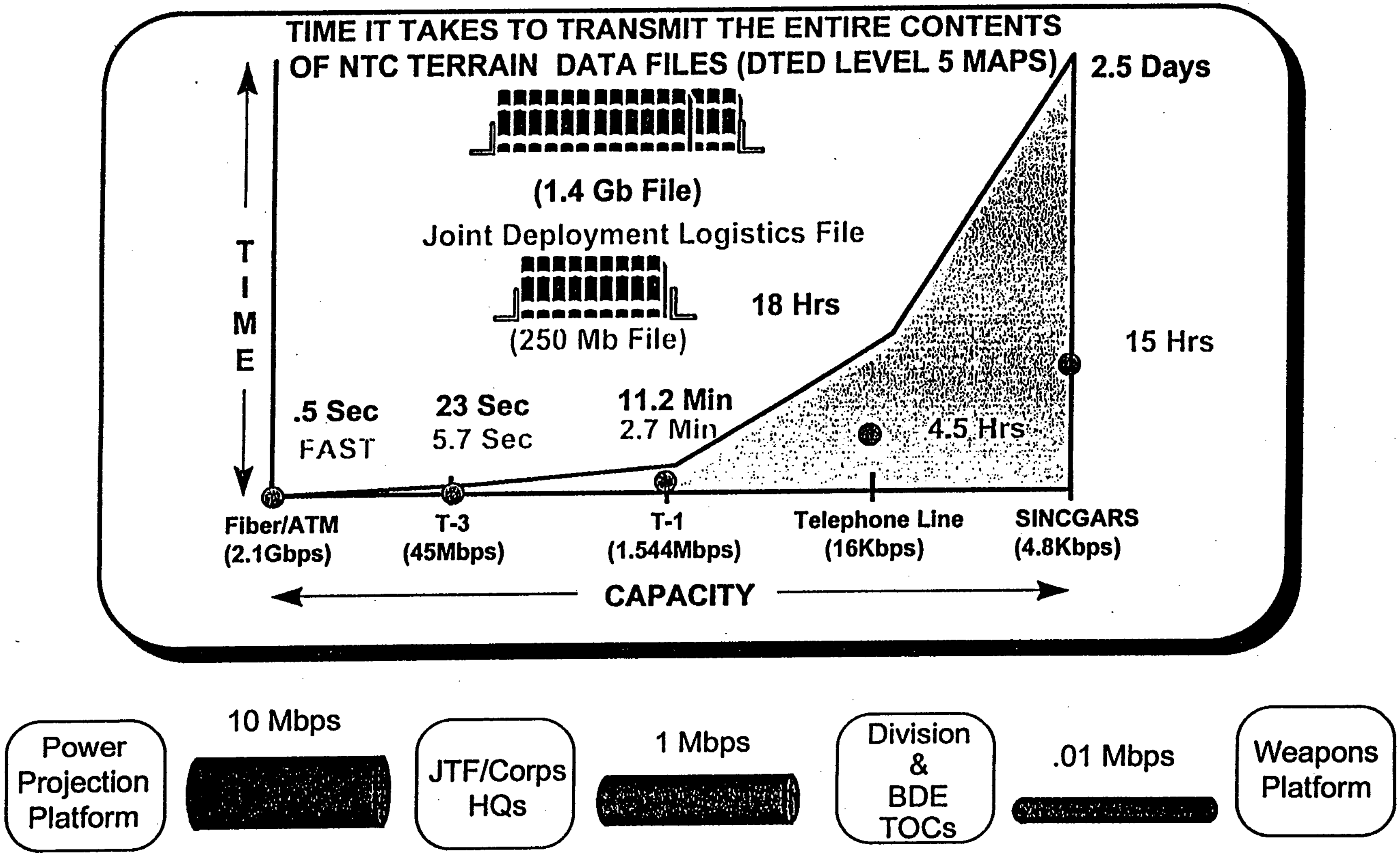
Bandwidth



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Warfighter Information Network

WARFIGHTER INFORMATION NETWORK

Power Projection Sustaining Base

Satellite Communications

An Evolving Integrated C4 Network Composed Primarily of Commercially Based, High Technology Information and Communication Systems. *WIN* is Designed to Increase the Capacity and Velocity of Information Distribution Throughout the Battlespace in Order to Gain Information Dominance. *WIN* will Maximize Information Services for the Warfighter and Support the Power Projection Force of the 21st Century from Sustaining Base to Fighting Platforms.

Information Systems / Services

Terrestrial Transport

Tactical Internet Combat Net Radios

Network Management

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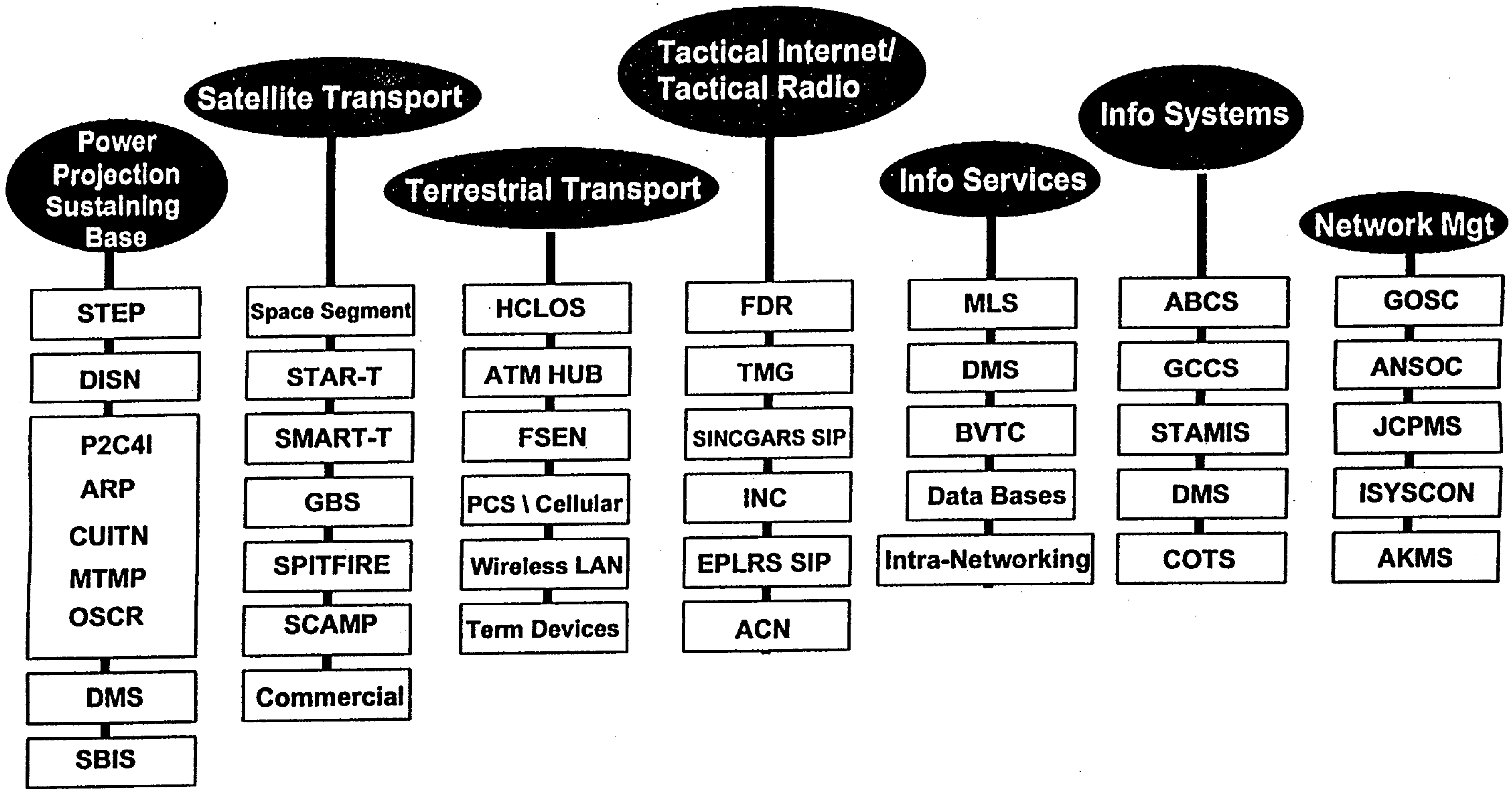
WIN Major Component Threads



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Power Projection Sustaining Base

PPSB

- **STEP** — **Standard Tactical Entry Point.**
  DISA Program, DII Master Plan, Joint CONOPS Aug 95, Present STEP Upgrades Funded.
- **DISN** — **Defense Integrated Switched Network.**
  DISA Program, DII Master Plan, ORD, FY 97 Contract Awards Funded by DISA.
- **P2C4I** — **Power Projection Command, Control, Communications, and Computers Infrastructure.**
  Army Installation Information Transfer Systems Improvement Program IITSP Jan 95.
- **CUITN** — **Common User Integrated Telephone Network.**
  Bragg-Done / Hood-Done / Stewart -Done/ Campbell-Done/ Shafter-FY00.
- **OSCAR** — **Outside Cable Repair Program.**
  Bragg-Done / Hood-Done / Stewart-Done / Campbell & Lewis-In Progress.
- **DMS** — **Defense Messaging System (Tactical).**
  ORD, Sustaining Base Infrastructure Fully Funded, Tactical DMS unfunded, Draft Tactical UFD.
- **RCAS** — **Reserve Components Automation System.**
  Fully Funded.
- **SBIS** — **Sustaining Base Information System.**
  Program Completed, Terminates FY 97.
- **ODOC** — **Objective DSCSOperations Center.**
  ORD approved Jan 96. IOTE in progress, Completed 3rd QTR 97.
- **MGV** — **Mobile Gateway Van.**
  5 systems fielded by ASC, 4 issued, 1 pending issue.

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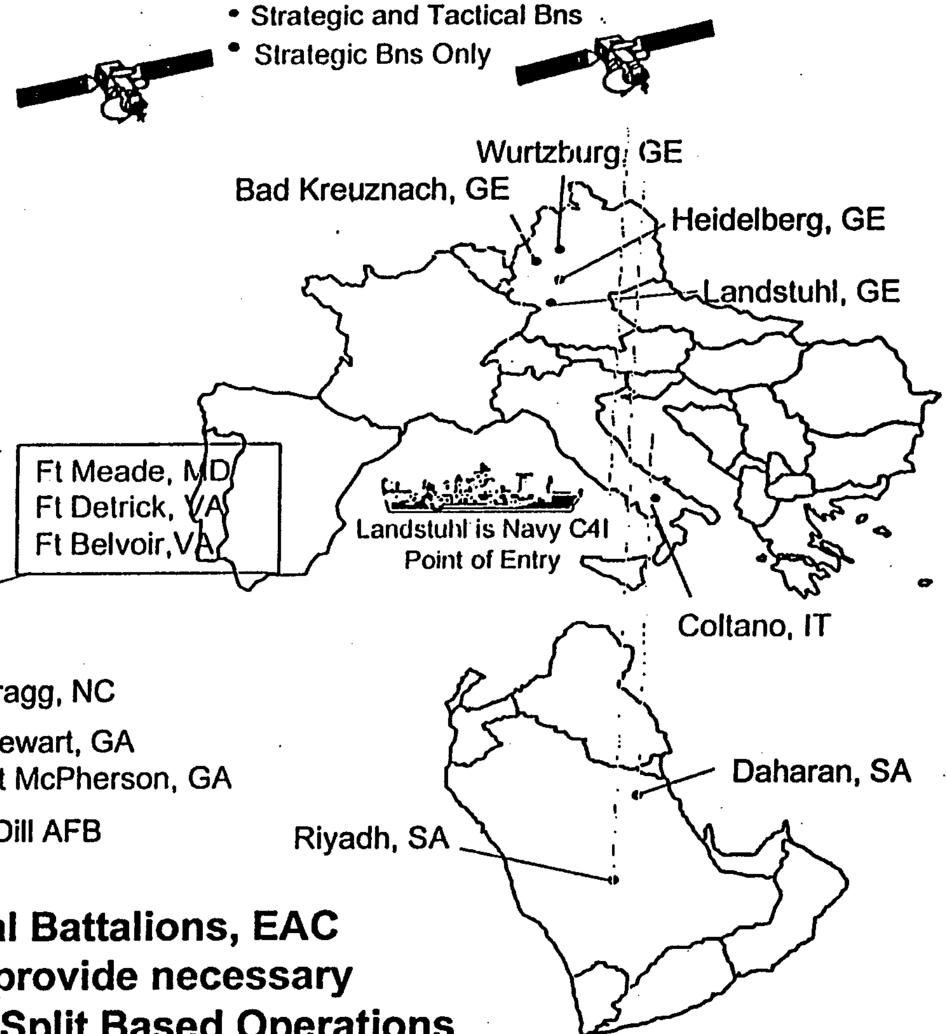
Signal Power Projection/Sustaining Base in MRC

k to Power Projection Platforms for:

(JOPES, TPFDL, USR, etc.)

portation Telemedicine
ce Total Asset Visibility
Theater Missile Defense
Personnel Replacements
Casualty Notification
eather AAFES
ide Web Supply Requisitions
Repair Parts



Step Sites, Strategic Signal Battalions, EAC
Tactical Signal Battalions provide necessary
Bandwidth and Connectivity for Split Based Operations

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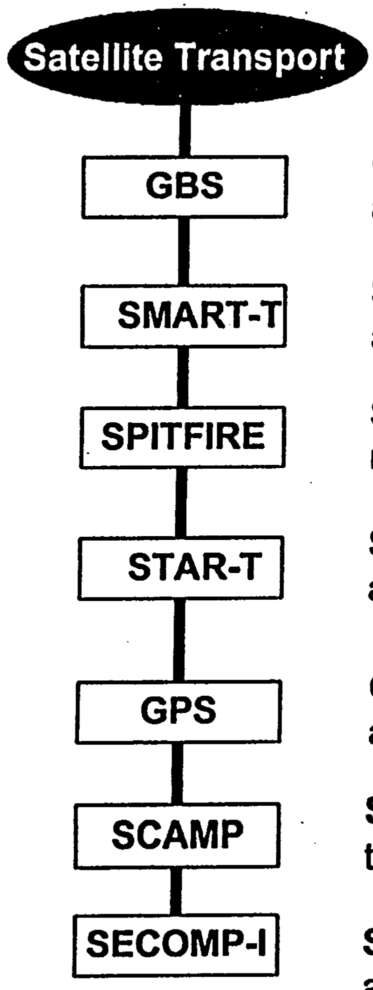
Satellite Transport



Global Broadcast Service. Funded for Phase II (Navy UHF Follow-on). Joint MNS approved Aug 95. Joint ORD approved by JROC 17 Mar 97.

Secure Mobile Antijam Reliable Tactical Terminal. Fully funded. Contract awarded Feb 96. LRIP delivery Mar 98. MS III review Oct 98. FUE Dec 99.

Spitfire. Funded for 2313 terminals; 3479 required. Terminals undergoing reverification testing, 3rd / 4th qtr FY 97.

SHF Tri-Band Advanced Range Extension Terminal. Fully funded. MNS approved Mar 94. ORD validated Jan 96. Contract awarded Jan 96. FUE Oct 99.

Global Positioning System. New funding begins FY00. ORD awaiting TRADOC approval.

Single Channel Anti-jam Manpackable Terminal. Funded for 150 Block I terminals; 660 required. Block I contract awarded Feb 96. FOT&E Jan 98.

Secure Enroute Communications Package - Improved. New start. ORD approved by TRADOC Feb 97.

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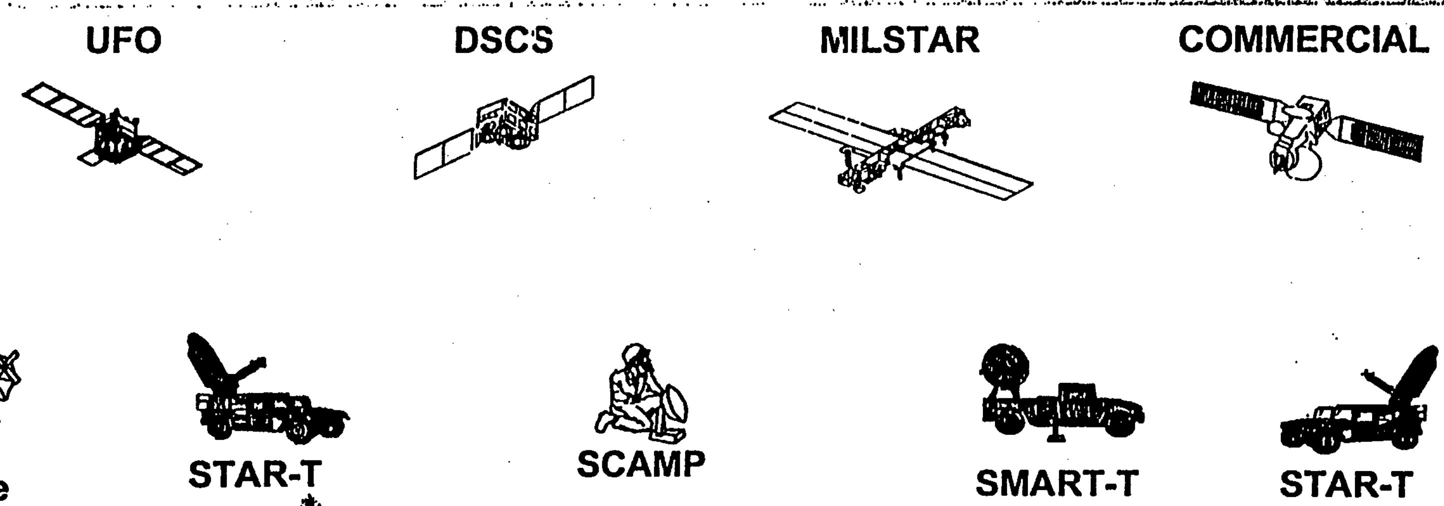
Satellite Transport

Warfighting Capabilities:

- Supports All Phases of Force Projection
  Split Based Operations
- Connects Widely Separated Enclaves
- MILSATCOM Provides Warfighter With Assured Access to SATCOM
- COMSATCOM Provides Increased Throughput

Proper Mix of Military and Commercial Satellite Systems, and existing Fiber Networks are Needed to Meet Requirements of a Power Projection Army



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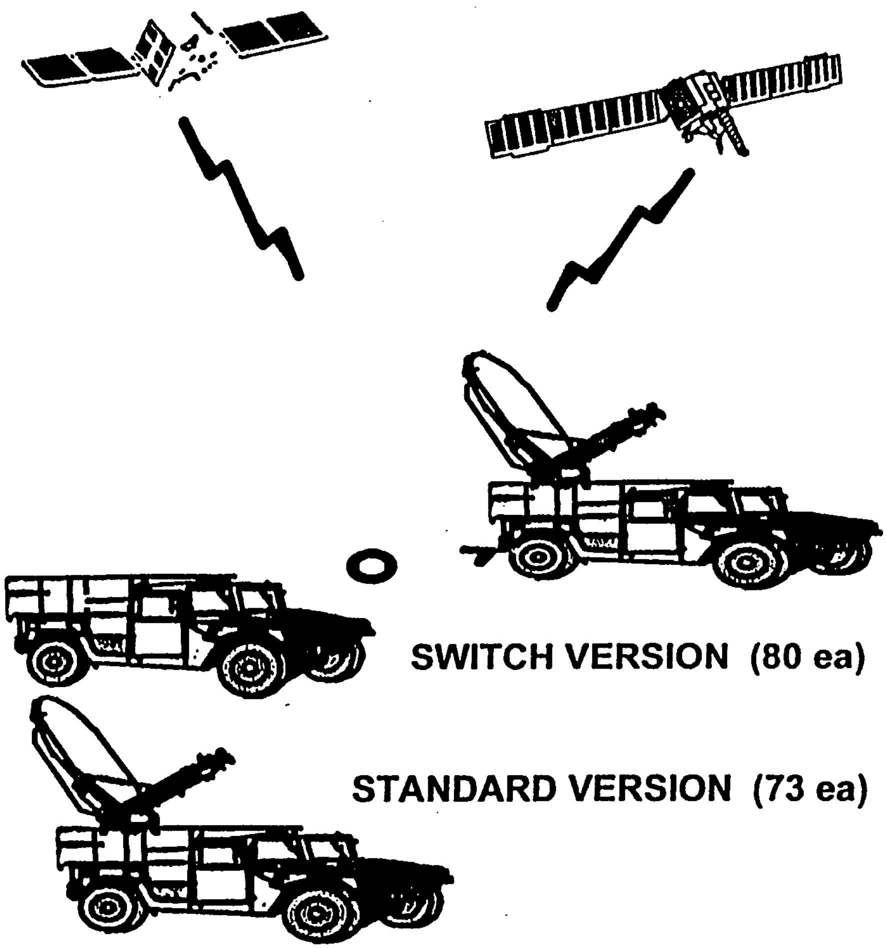
STAR-T



- SHF TRI-BAND-X, C, Ku BAND
- MULTI NODE (4 LINKS MINIMUM)
- 2 VERSIONS-WITH AND W/O SWITCH
- 30 MINUTES SET-UP/TEAR-DOWN
- INTERFACE WITH TRI-TAC, MSE, DISN, TPN
- HEAVY HMMWV MOUNTED, C-130 ROLL-ON/OFF
- 8.192 MB/S THROUGHPUT
- REMOTE CONTROL OPERABLE, ON-BOARD GPS
- REPLACEMENT FOR AN/TSC-85/93s AT EAC
- PROVIDES RANGE EXTENSION OF THE ACUS FOR SYSTEMS AT EAC AND SELECTED ECB UNITS
- INTEGRATED SWITCH CAPABLE OF PROVIDING SERVICE TO 280 SUBSCRIBERS

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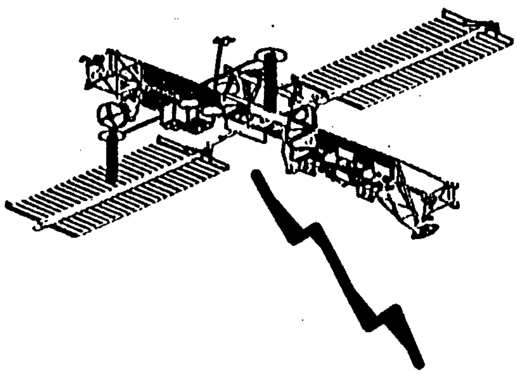
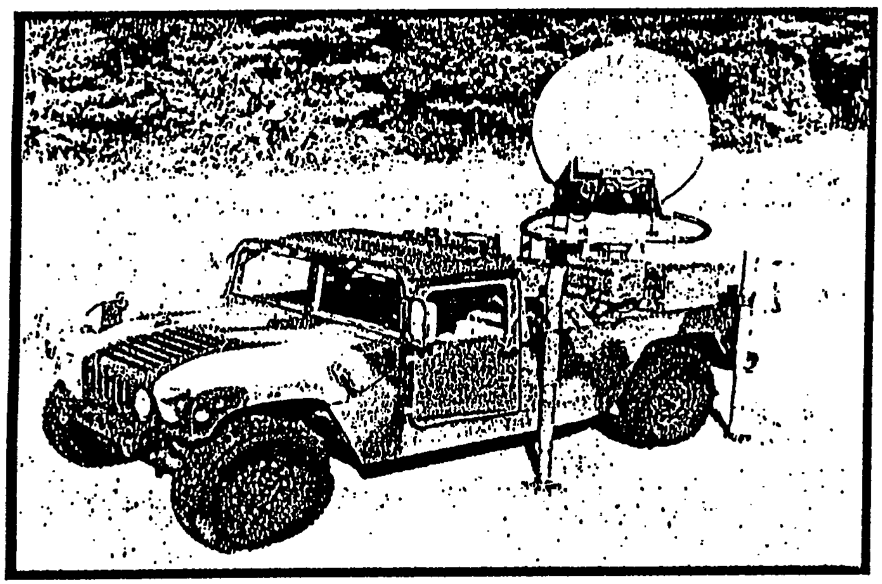
SMART-T





RAYTHEON SMART-T

- RANGE EXTENSION OF MOBILE SUBSCRIBER EQUIPMENT (MSE)
- OPERATE AT 16 Kbps TO 1.544 Mbps
- RAPID SET-UP / TEAR-DOWN 30 MINUTES
- UNATTENDED REMOTE OPERATION
- PERFORMS AS MILSTAR NETWORK MANAGEMENT TERMINAL
- INTEROPERABLE WITH MILSTAR SATELLITES, FLEETSAT EHF PACKAGES (FEP), AND EHF PACKAGES ON UHF FOLLOW-ON (UFO)
- EMBEDDED TRANSEC ONLY; ACCEPTS DATA ENCRYPTED BY USER
- PRIMARY POWER FROM STANDARD ARMY 28 VDC GENERATORS
  - CAPABLE OF USING VARIOUS COMMERCIAL POWER (110 VAC / 60 Hz, 220 VAC / 50 Hz, SINGLE & THREE PHASE)

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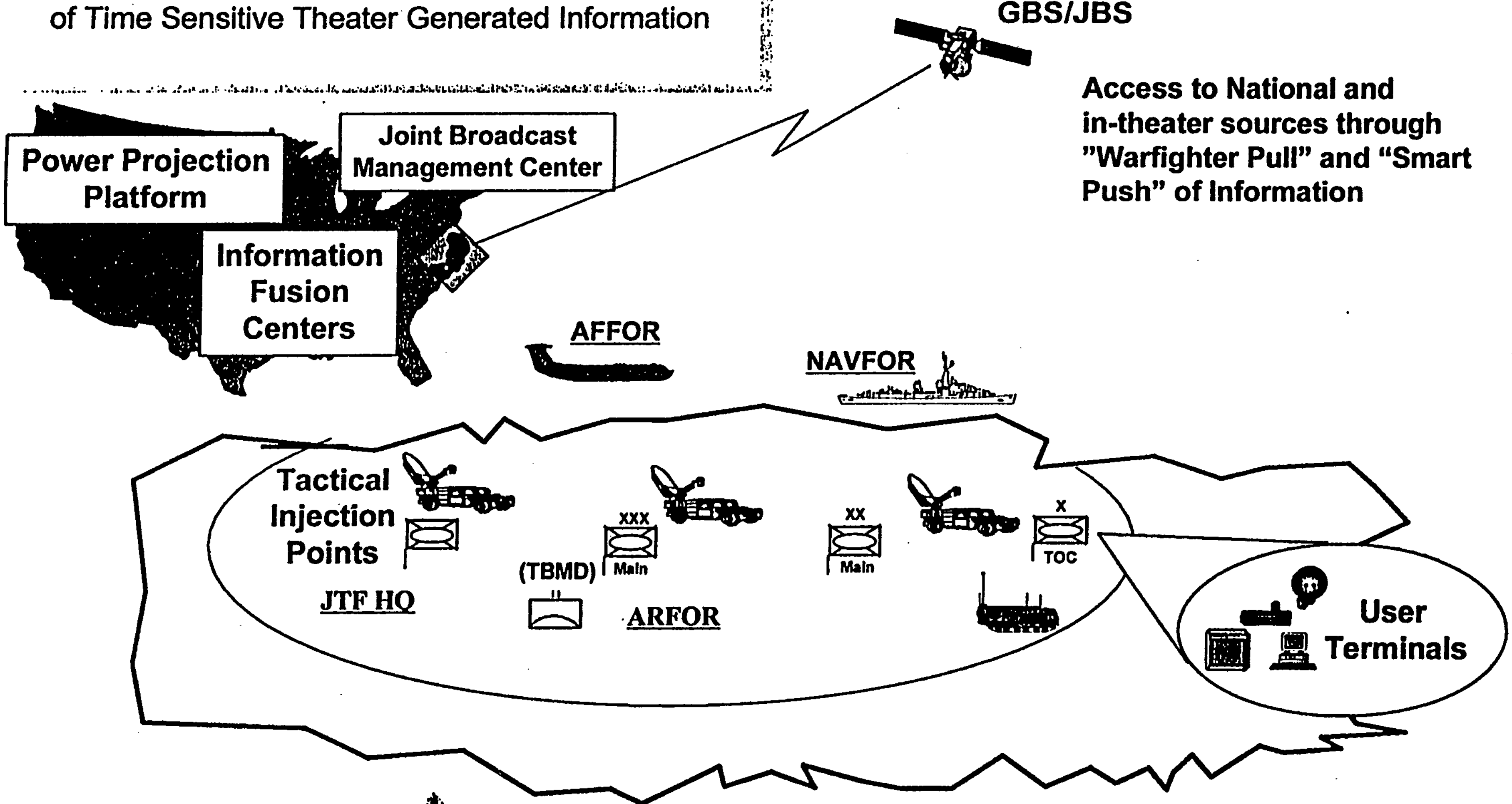
Global Broadcast Service

Warfighting Capabilities:

- One Way Broadcast of Video and High Data Rate Information
- In Theater Tactical Injection Points for Broadcast of Time Sensitive Theater Generated Information



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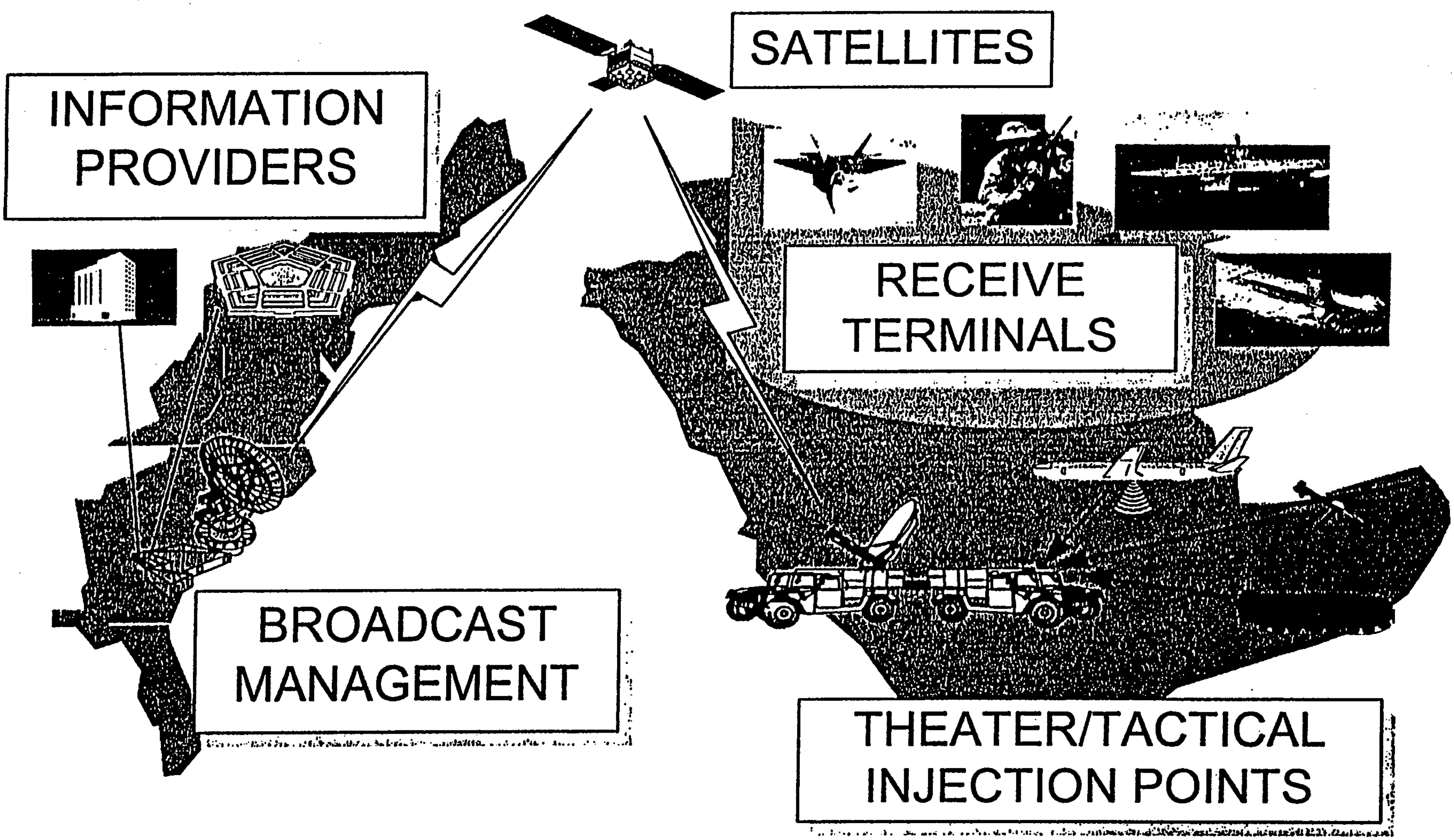
GBS Components



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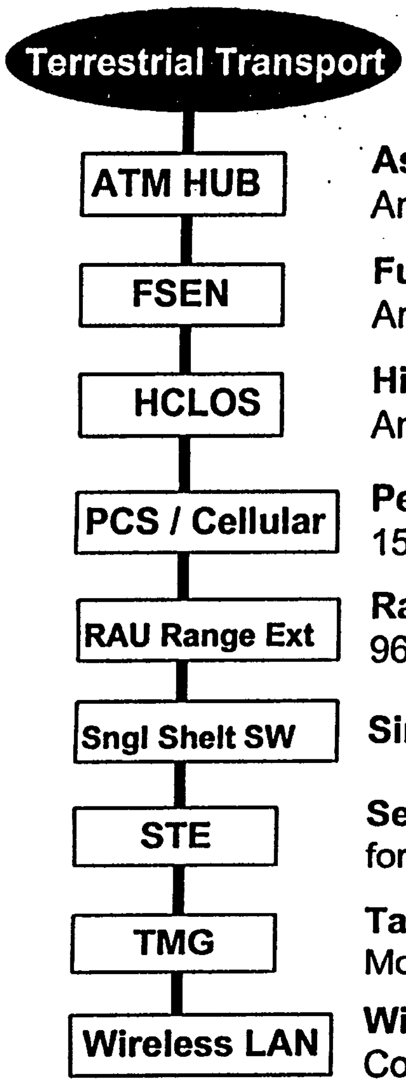
Terrestrial Transport



Asynchronous Transfer Mode Hub. ACUS Modernization Plan approved 15 Aug 96; Annex to WIN UFD. Both under development.

Future Small Extension Node. ACUS Modernization Plan approved 15 Aug 96; Annex to WIN UFD. Both under development.

High Capacity Line-of-Sight Radio. ACUS Modernization Plan approved 15 Aug 96; Annex to WIN UFD. PM JTACS market spec and technical survey Dec 96.

Personal Communications Services / Cellular. ACUS Modernization Plan approved 15 Aug 96. Concept exploration. Future annex to WIN UFD, to be published FY 99.

Radio Access Unit Range Extension. ACUS Modernization Plan approved 15 Aug 96. Fully funded. FUE FY 01.

Single Shelter Switch. Purchase 17 systems FY 99-01.

Secure Terminal Equipment. ACUS Modernization Plan approved 15 Aug 96; UFD for STE under development. Future annex to WIN UFD. First buy of 1100 FY 97.

Tactical Multinet Gateway. MNS approved 16 Jan 96. Transitioned to ACUS Modernization Plan. Prototype used in TF XXI AWE. Future annex to WIN UFD.

Wireless Local Area Network. ACUS Modernization Plan approved 15 Aug 96. Concept exploration. Interim COTS solution is user funded. Future annex to WIN UFD.

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Why Must We Upgrade ACUS ?

Warfighter Requirement "*...fused, real-time, true representation of the Joint Battlespace*"

DISN Capstone Requirements Document

MSE/TRI-TAC 16/32Kbs

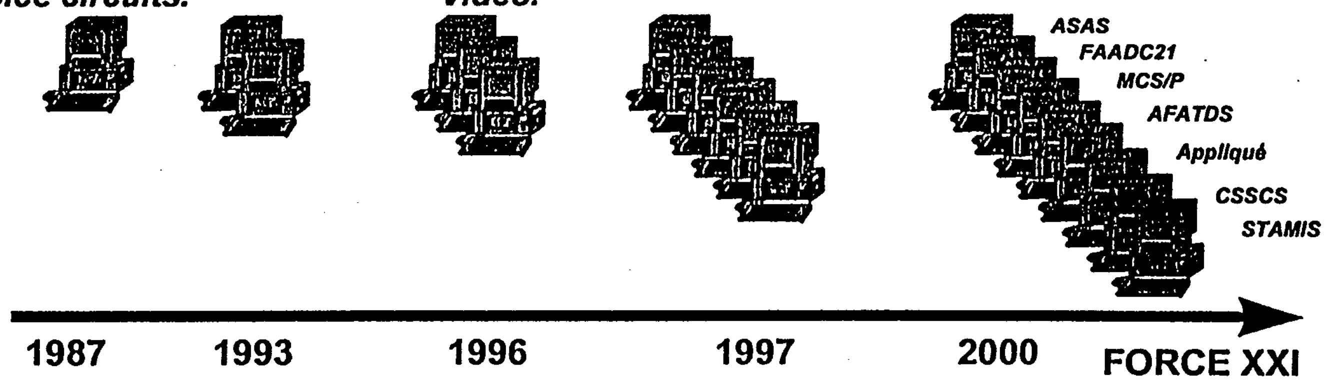
When MSE was fielded, voice made up 98% of the bandwidth requirement. Data supported by dedicated channels over voice circuits.

MSE/TRI-TAC 16/32Kbs

When the TPN was fielded in MSE & TRI-TAC, fixed voice made up 93% of the bandwidth requirement, data made up 7%. 0% for Video!

MSE/TRI-TAC 16/32Kbs

In the future, the voice requirements will remain steady while data, video, and imagery requirements will continue to expand!



Can't support Force XXI requirements with "chrome plated" TRI-TAC/MSE !

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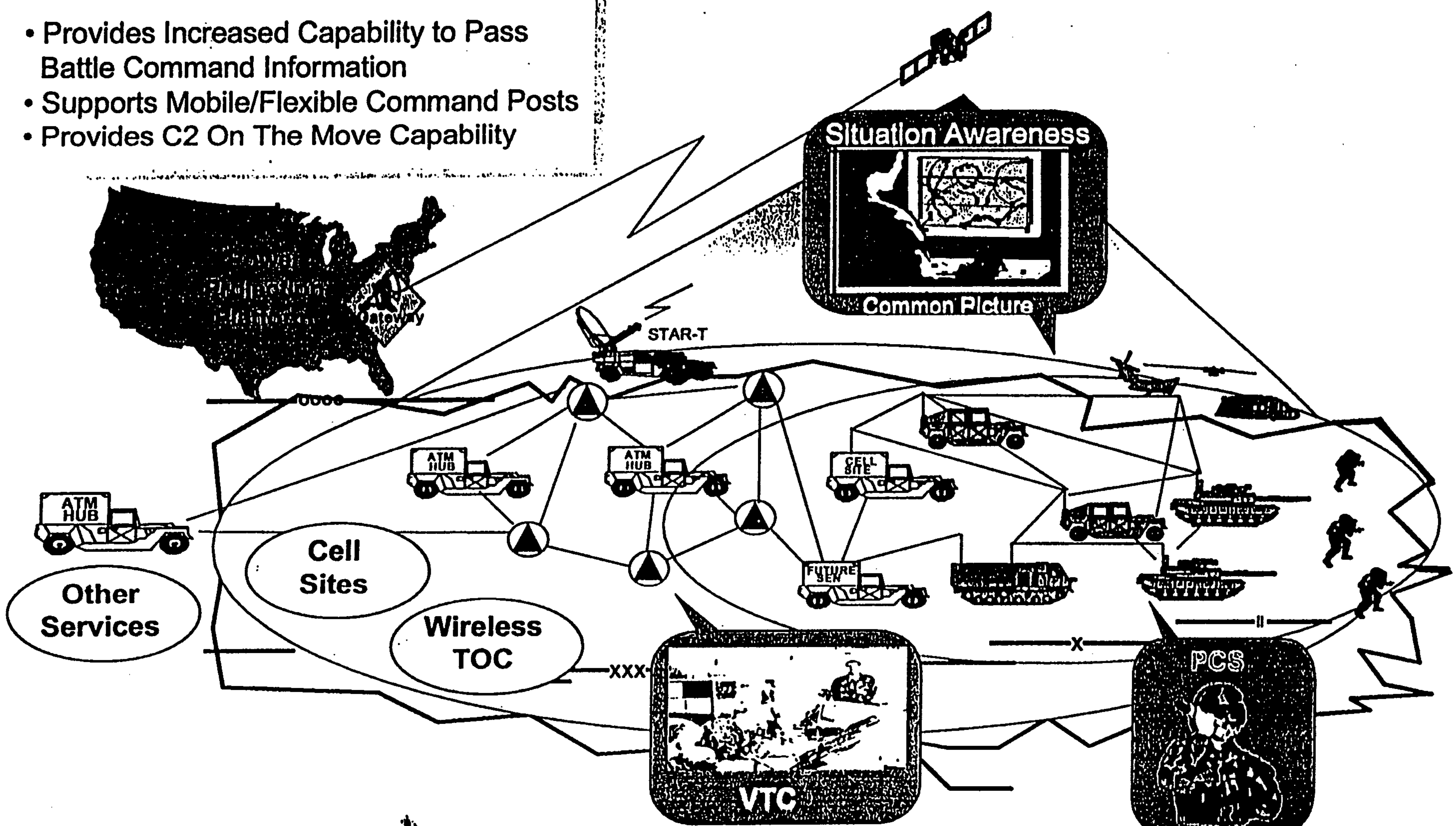
Terrestrial Transport

Warfighting Capabilities:

- Provides Increased Capability to Pass Battle Command Information
- Supports Mobile/Flexible Command Posts
- Provides C2 On The Move Capability



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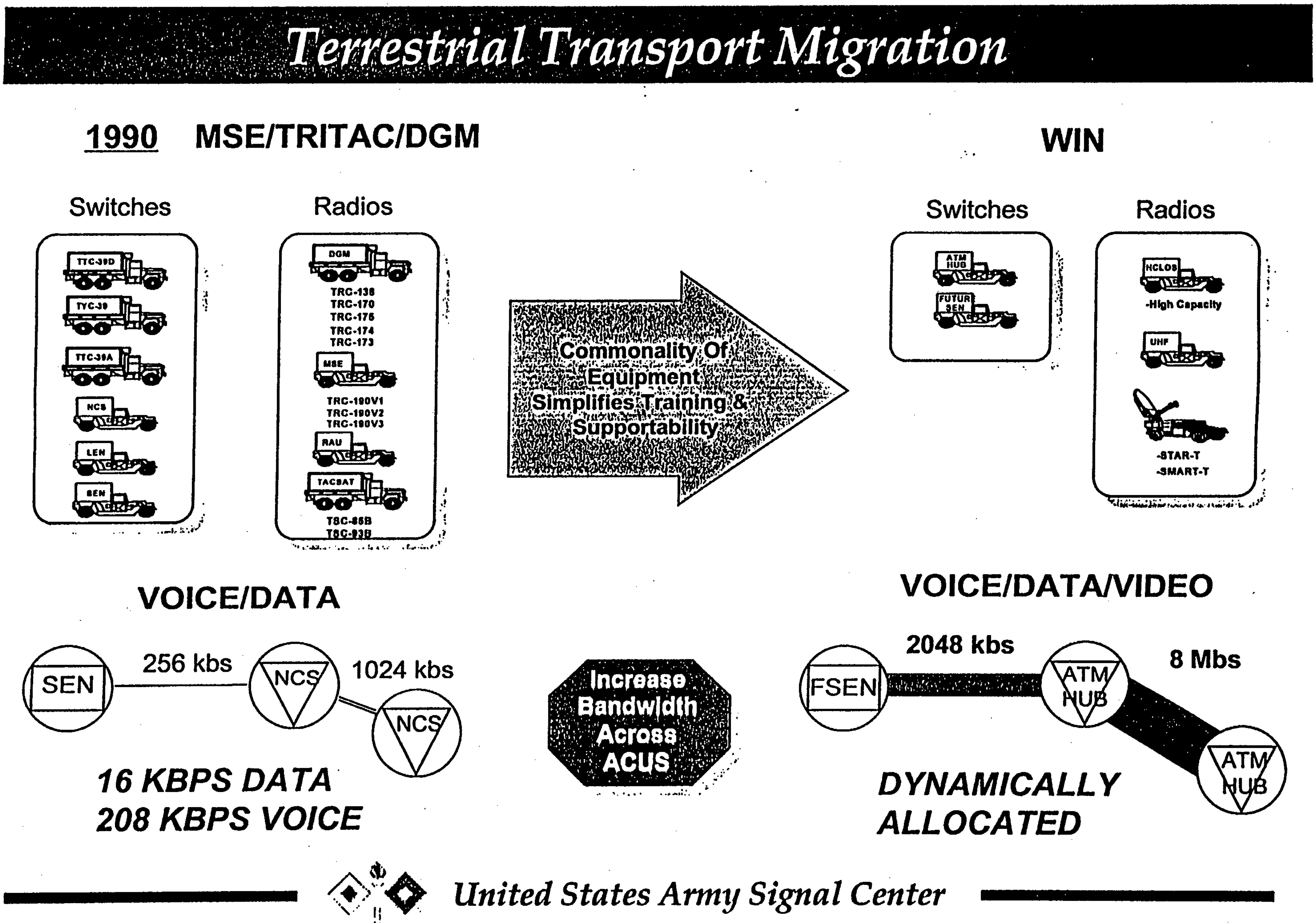
Terrestrial Transport Migration
1990 MSE/TRITAC/DGM
WIN
Switches
Radios
TTC-39D
TYC-39
TTC-39A
NCS
LEN
SEN
DGM
TRC-138
TRC-170
TRC-175
TRC-174
TRC-173
MSE
TRC-190V1
TRC-190V2
TRC-190V3
RAU
TACSAT
TSC-85B
TSC-93B
Commonality Of Equipment Simplifies Training & Supportability
Switches
Radios
ATM HUB
FUTUR SEN
HCLOS
-High Capacity
UHF
-STAR-T
-SMART-T
VOICE/DATA
SEN
256 kbs
NCS
1024 kbs
NCS
16 KBPS DATA
208 KBPS VOICE
Increase Bandwidth Across ACUS
VOICE/DATA/VIDEO
FSEN
2048 kbs
ATM HUB
8 Mbs
ATM HUB
DYNAMICALLY ALLOCATED
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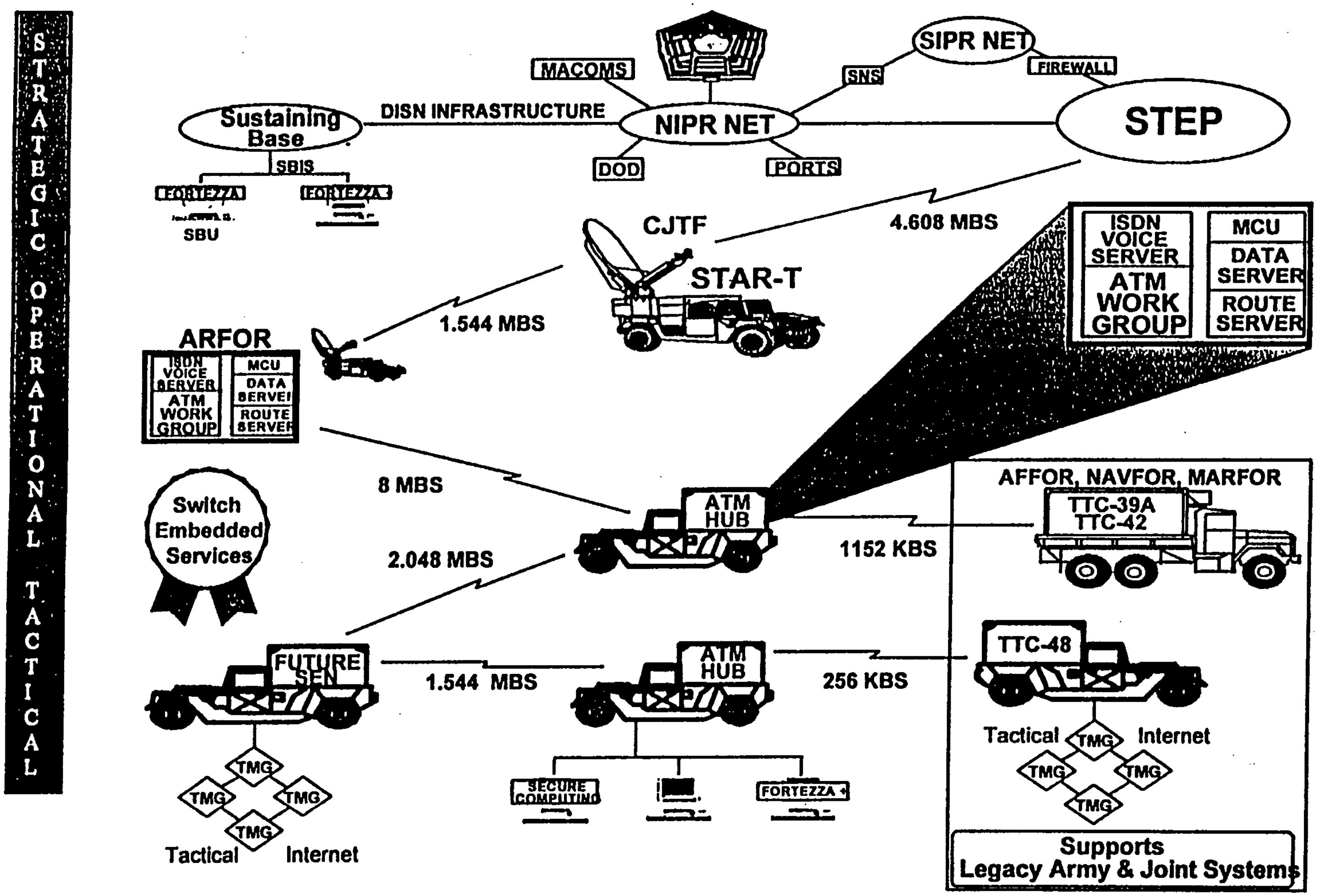
Objective WIN Terrestrial Transport System

Leverages ATM & ISDN Technology While Concurrently Supporting Legacy Systems !



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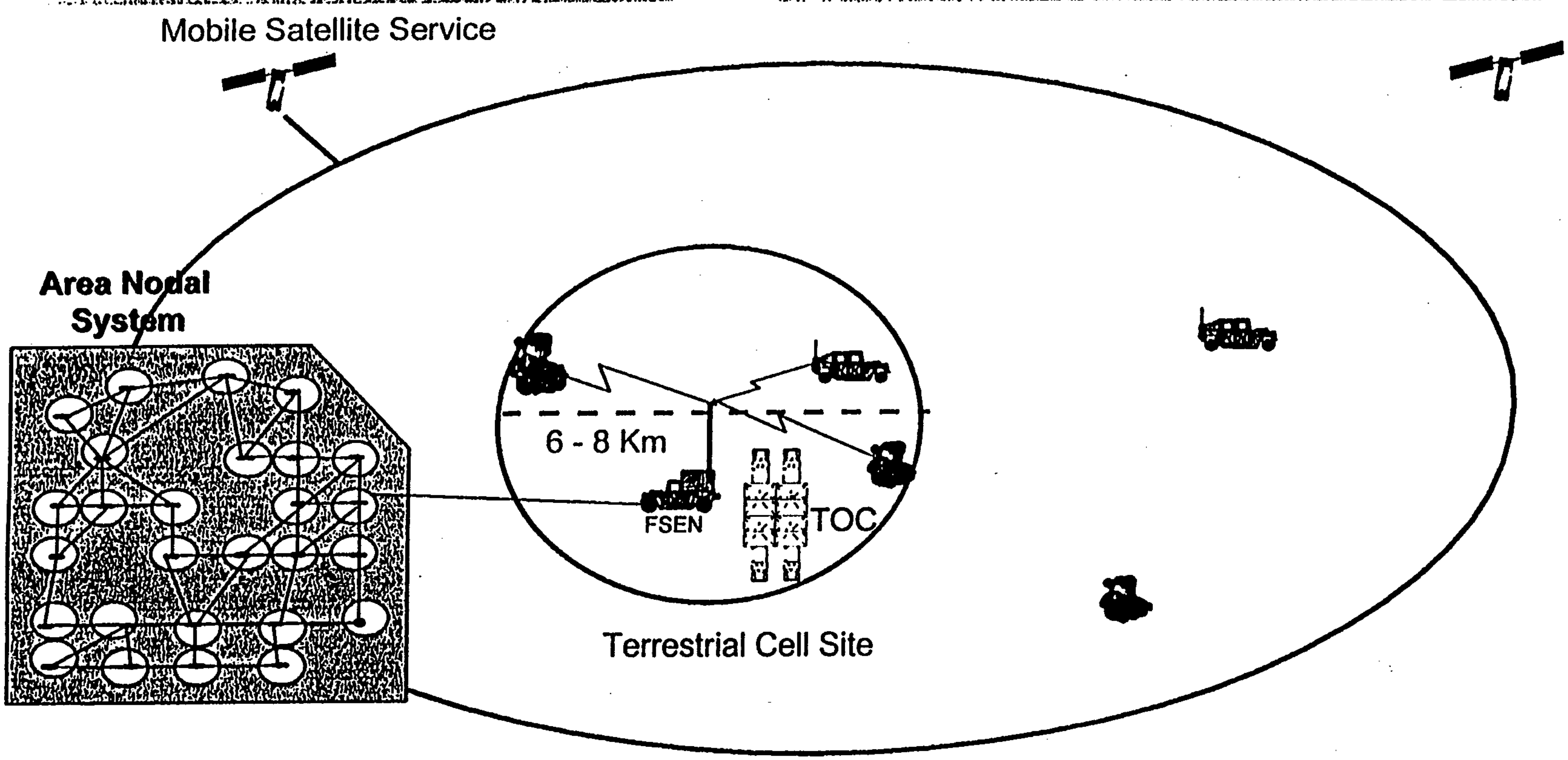
Personal Communications Service

Warfighting Capabilities:

- Provides Total Battlefield Coverage
- Supports Mobile/Flexible Command Posts
- Provides C2 On The Move Capability

PCS - Primarily a voice system with limited data capability. Integration of terrestrial and satellite systems.



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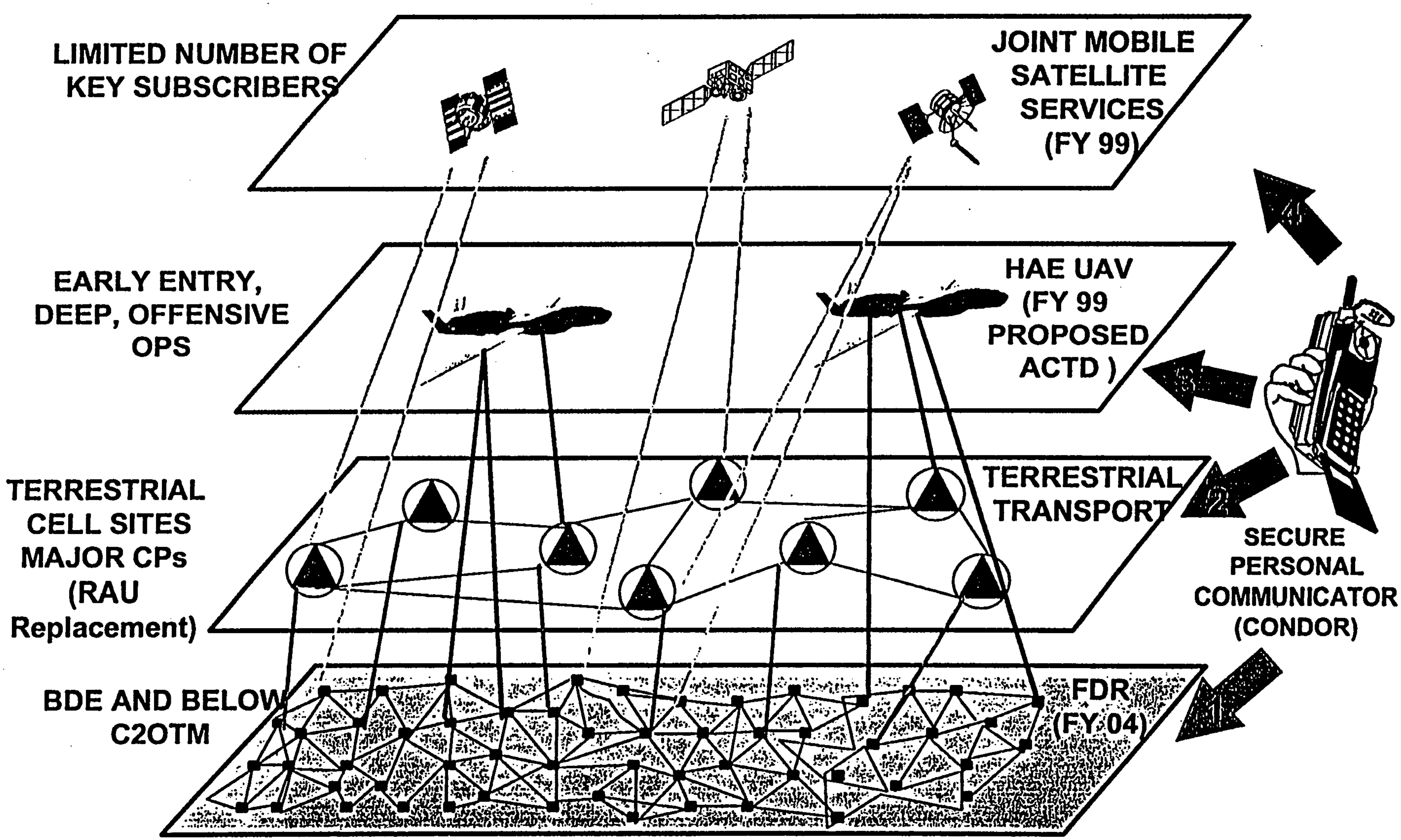
PCS Objective Transport Paths



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Tactical Internet / Tactical Radio

Tactical Internet/ Tactical Radio

EPLRS SIP	**Enhanced Position Location Reporting System - System Improvement Plan.** ORD 28 Nov 95. Currently in Operational Test. MS III Mar 97.
FDR	**Future Digital Radio.** MNS approved May 96; Draft ORD Released for Staffing Feb 96.
SINCGARS SIP	**Single Channel Ground and Airborne Radio System - System Improvement Plan.** SIP approved 17 Nov 92. Down selected Apr 97. Production ends FY 98.
ACN	**Airborne Communications Node.** ACUS Modernization Plan approved 15 Aug 96. Annex to ORD for High Altitude Endurance UAV. Awaiting Approval at HQDA.
APPLIQUE	**Appliqué.** MNS approved Oct 94. FBCB2 ORD approved 5 Mar 97.
FHMUX	**Frequency-Hopping Multiplexer.** Partially funded. Pre-production models used in TF XXI AWE. ROC being revised to incorporate MSRT.
TI	**Tactical Internet.** Draft MNS internally staffed Mar 97. ORD to be issued Sep 97.

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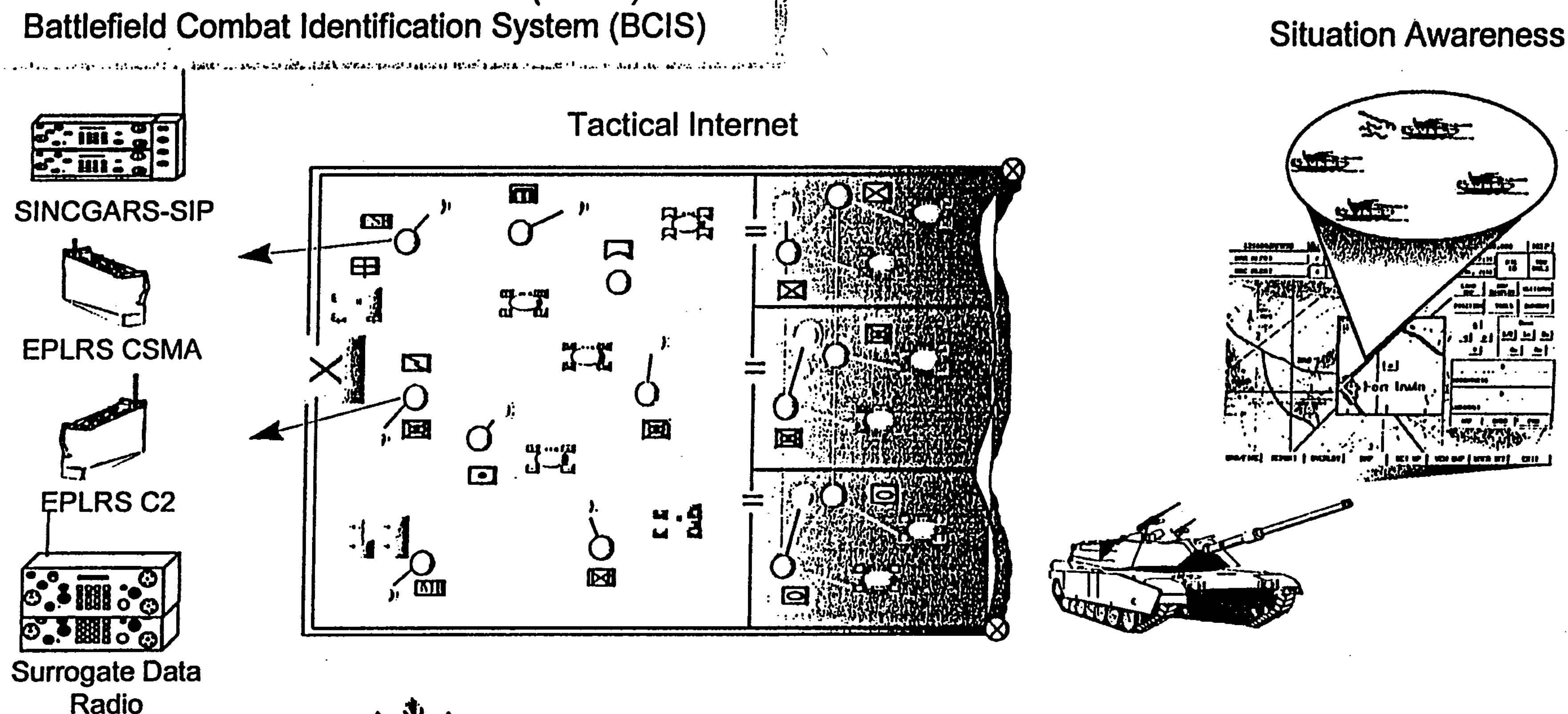
Tactical Internet/Combat Net Radio

Warfighting Capabilities:

- C2 for Brigade and Below
- Supports Battle Command, Battlefield Visualization, Situational Awareness
- Message Exchange with ABCS at TOC Level
- Extends ABCS to Soldier/Weapons Platform
- Feeds from GPS Position Location (PLGR) and Battlefield Combat Identification System (BCIS)



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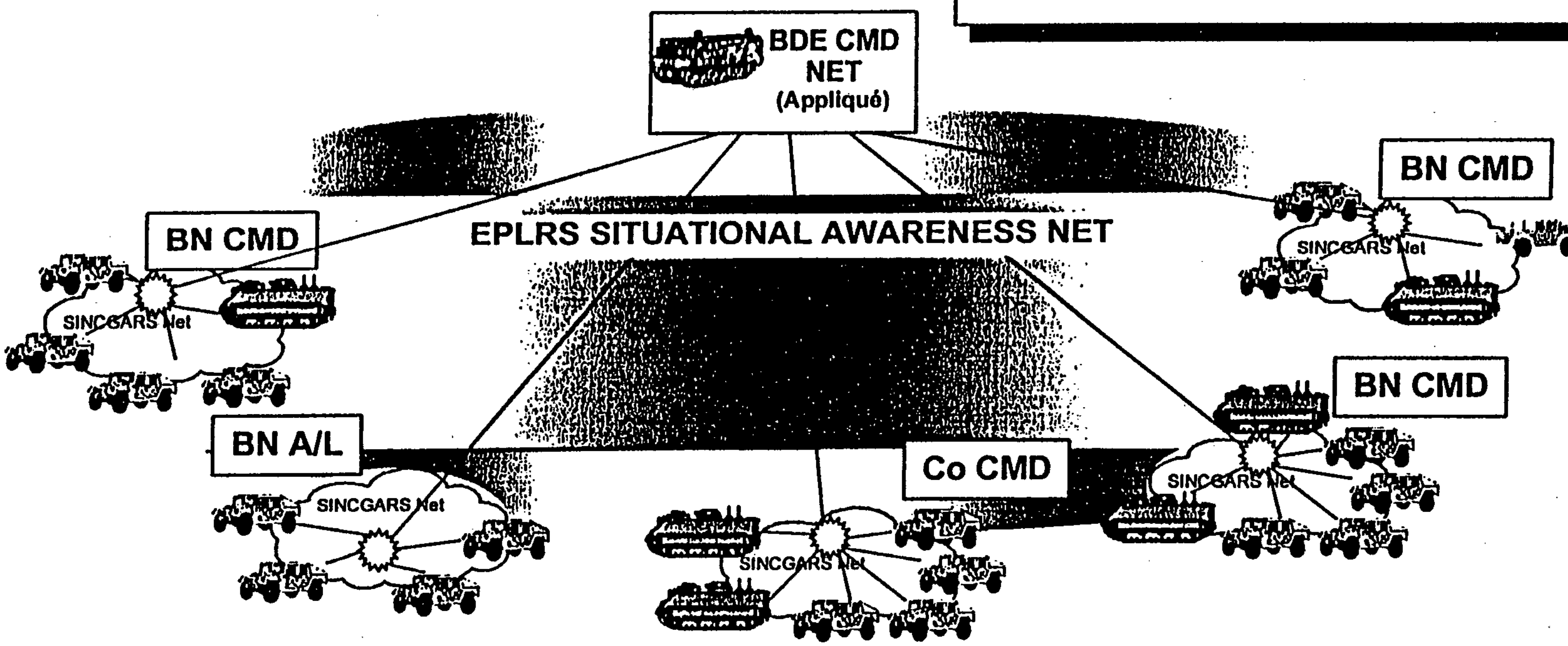
Tactical Internet/Tactical Radio

Tactical Internet Supports
- Situational Awareness
- Battle Command
- Engagement Ops
- Network Communications at Brigade and Below

- Extends Army Battle Command Systems to the Soldier/Weapons Platform Level
- Near Term: Integrates Improved Legacy SINCGARS, EPLRS and Routers
- Far Term: Embeds Voice, Data and Routing In One Radio (FDR)



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Observations

- Appliqué - EPLRS Provides Excellent Situational Awareness.
- SINCGARS Voice-Data Contention Inhibits the Warfighter's Command And Control (C2).
- Current TI Can Not Support Task Organization on the Move.
- *Range Extension* for Scouts, CSS, and Mobile C2 Platforms and Higher Hqs a Key Requirement.
- *Above All Else, Simplify the Architecture and Make It Easier on both the Signal and the User Soldiers!*

Baseline Requirement for FDR Is a High Capacity Networked Data Radio That Supports Multiple Host Computers

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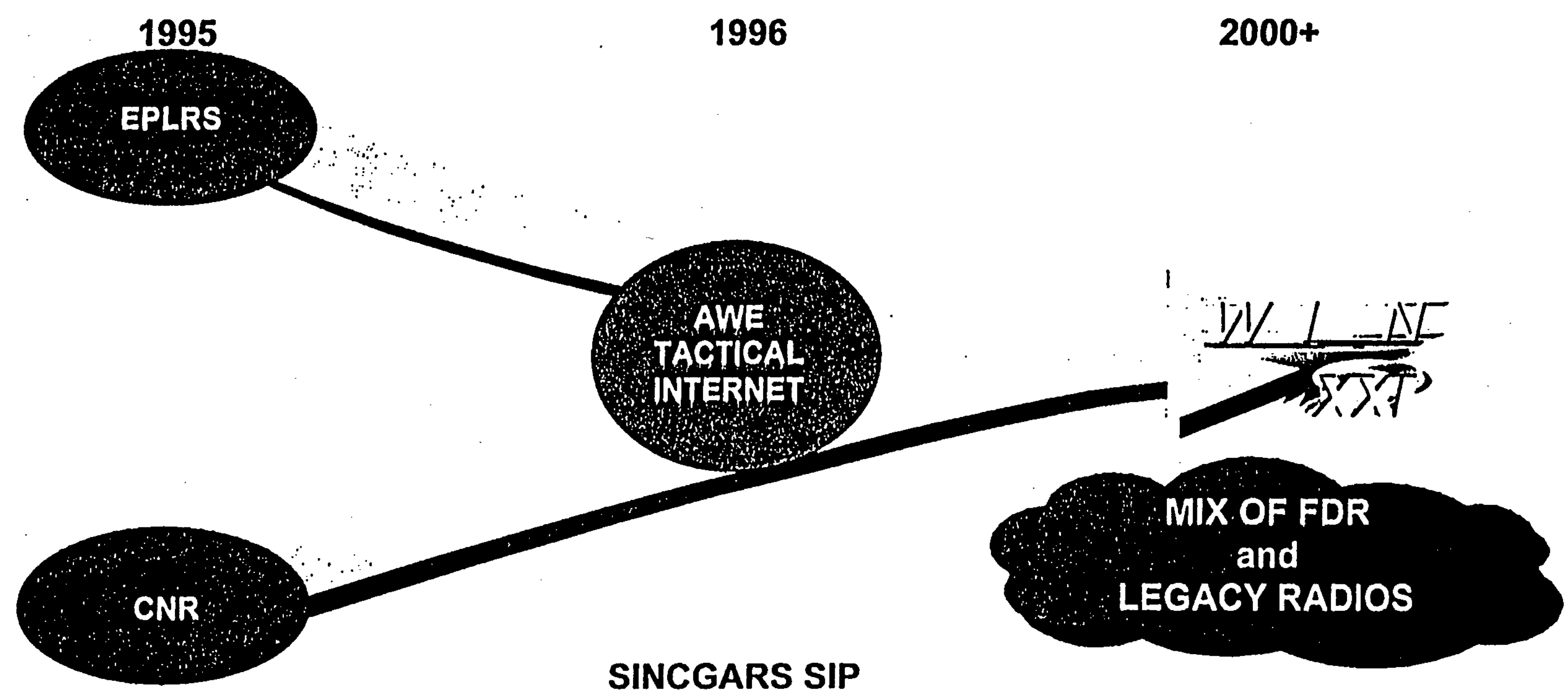
Transition To FDR



SINCGARS

- Single Function Radios
- Minimal Data Requirements
- Primarily Voice C2

SINCGARS SIP
EPLRS VHSIC

- Greater Voice and Data Capability
- Dedicated Data Radio
- Exploding Data Requirements
- Legacy Systems to Capacity

- Multiband, Multimode Digital (Voice and Data)
- Bigger Data Pipe
- Integrated and Networked C4 at B2

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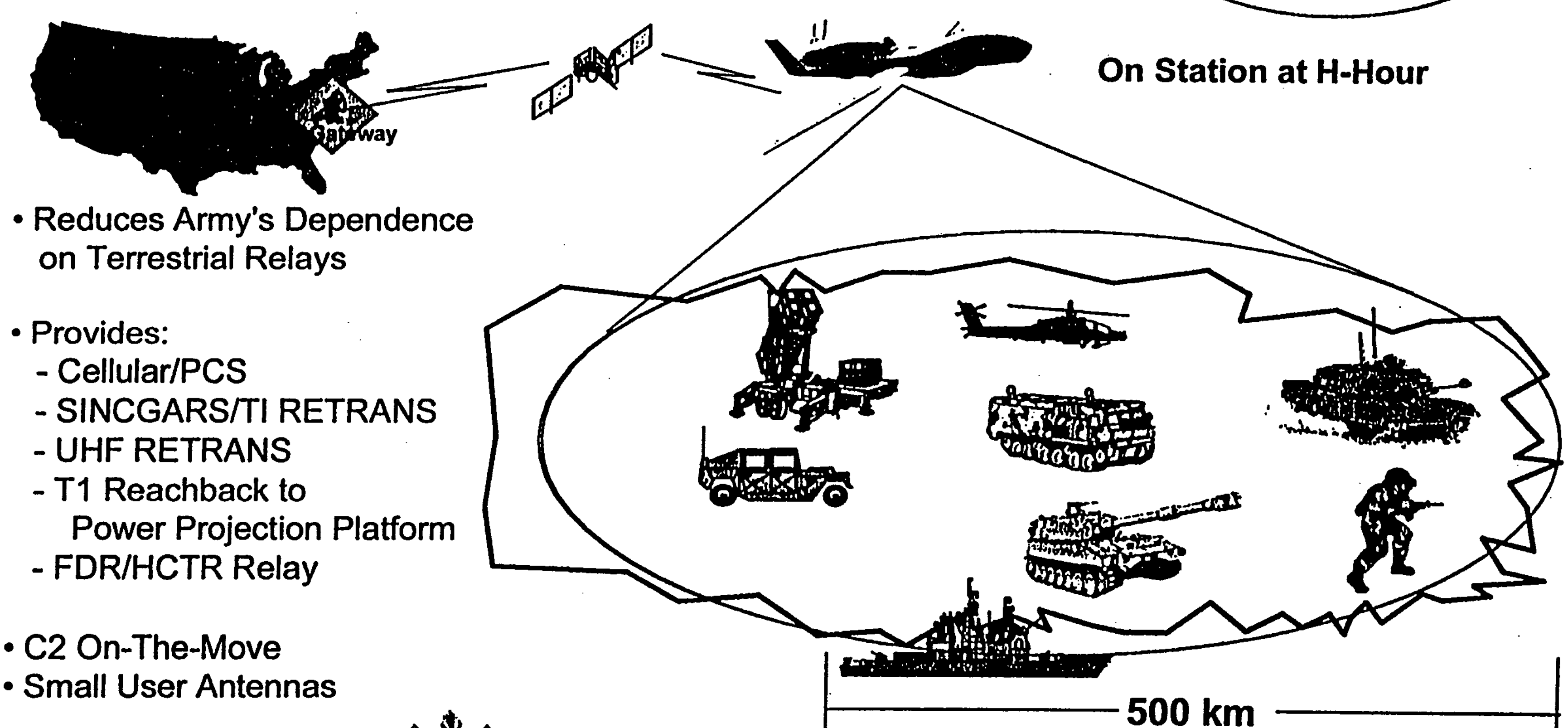
Airborne Communications Node

Warfighting Capabilities:

An Aerial Communications Payload That Provides:
- Over the Horizon Communications
- Reachback Connectivity,
- Communications On the Move
- Gateways for Seamless Communications

ACN Support
- **Early Entry**
- **Deep Ops**
- **Major Offensive Ops**



- Reduces Army's Dependence on Terrestrial Relays

- Provides:
  - Cellular/PCS
  - SINCGARS/TI RETRANS
  - UHF RETRANS
  - T1 Reachback to Power Projection Platform
  - FDR/HCTR Relay

- C2 On-The-Move
- Small User Antennas

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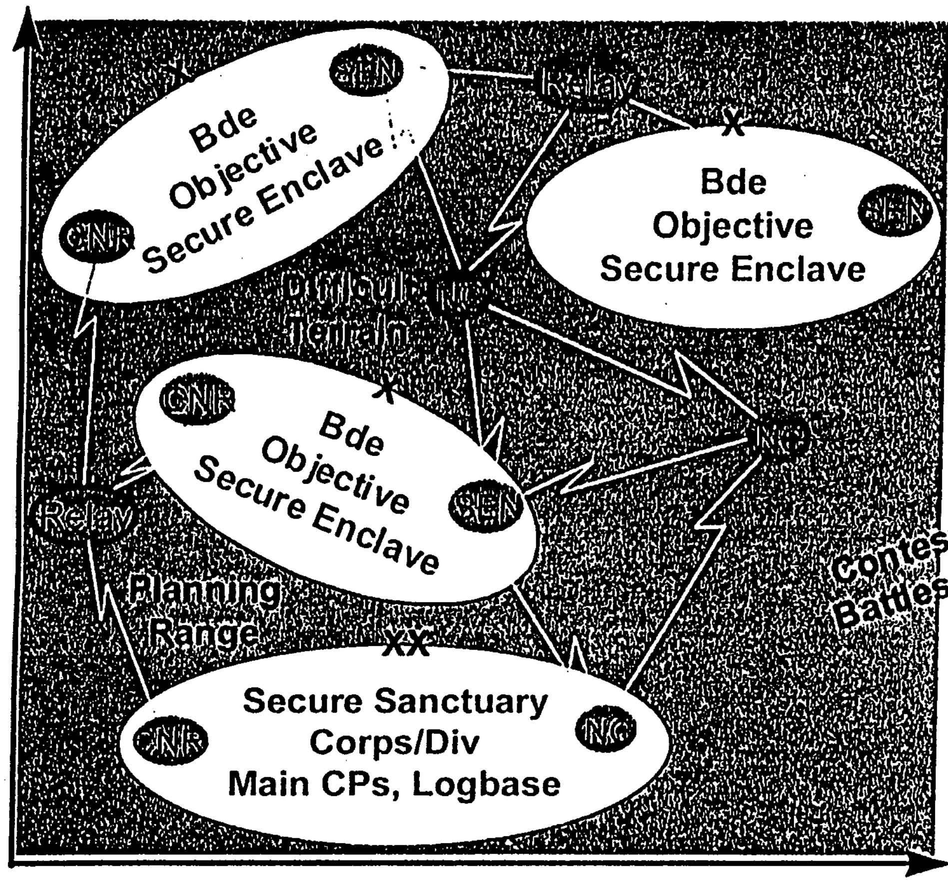
Force XXI - ACN Required For Connectivity

CORPS AREA OF OPERATIONS



New Nonlinear Force Projection Offensive

- o ACN on station at H Hour to support earliest entering forces.
- o ACN provides range extension while terrestrial relays are being established.
- o If you lose a UAV, you only lose equipment, not lives.
- o Augments but does not replace satellite connectivity.
- o Provides range extension for the tactical internet (FDR, SINCGARS SIP, EPLRS, and HCTR).

DIGITIZATION INCREASES REQUIREMENTS FOR THROUGHPUT AND BEYOND LINE OF SITE CONNECTIVITY.

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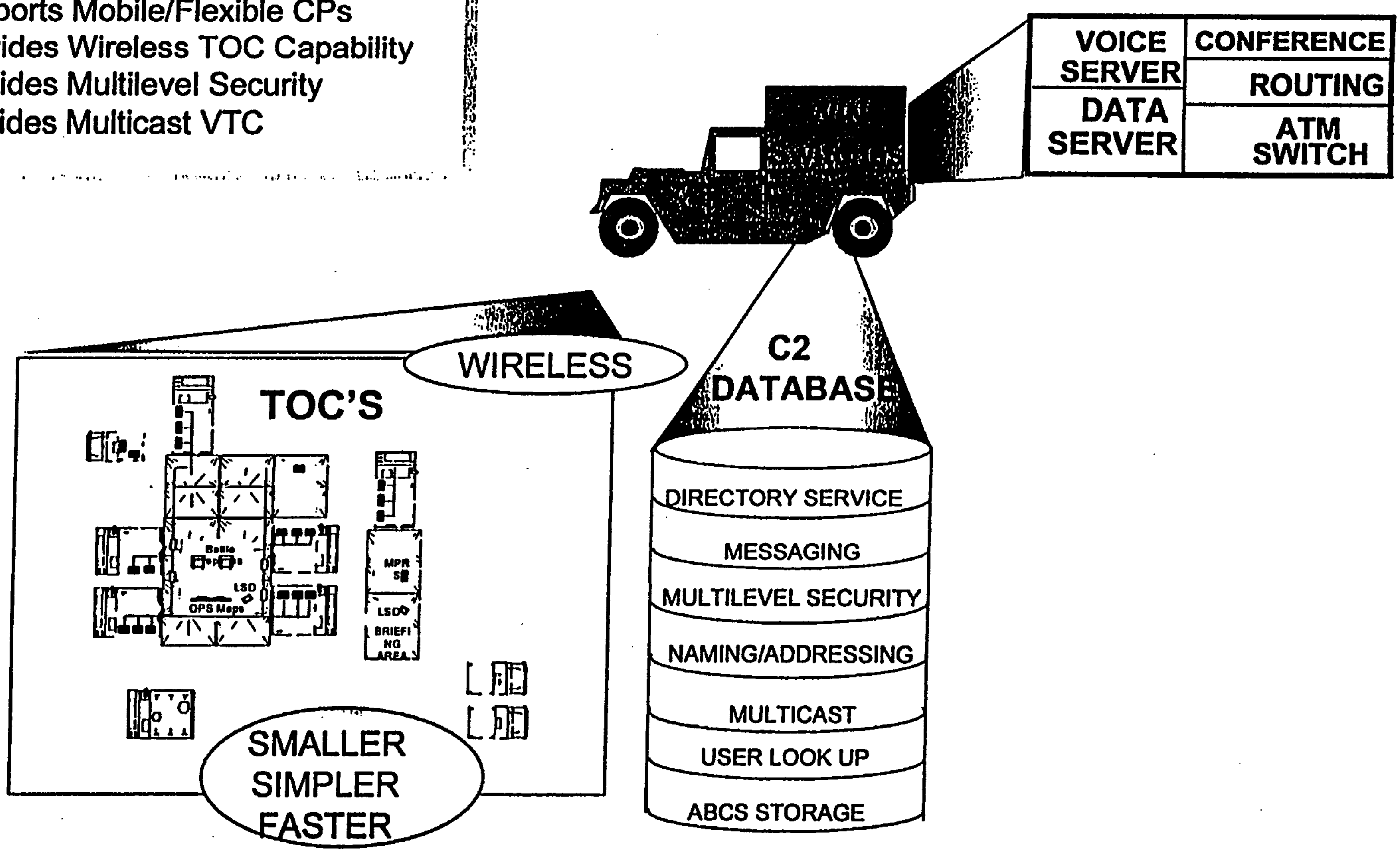
Information Systems and Services

Warfighting Capabilities:

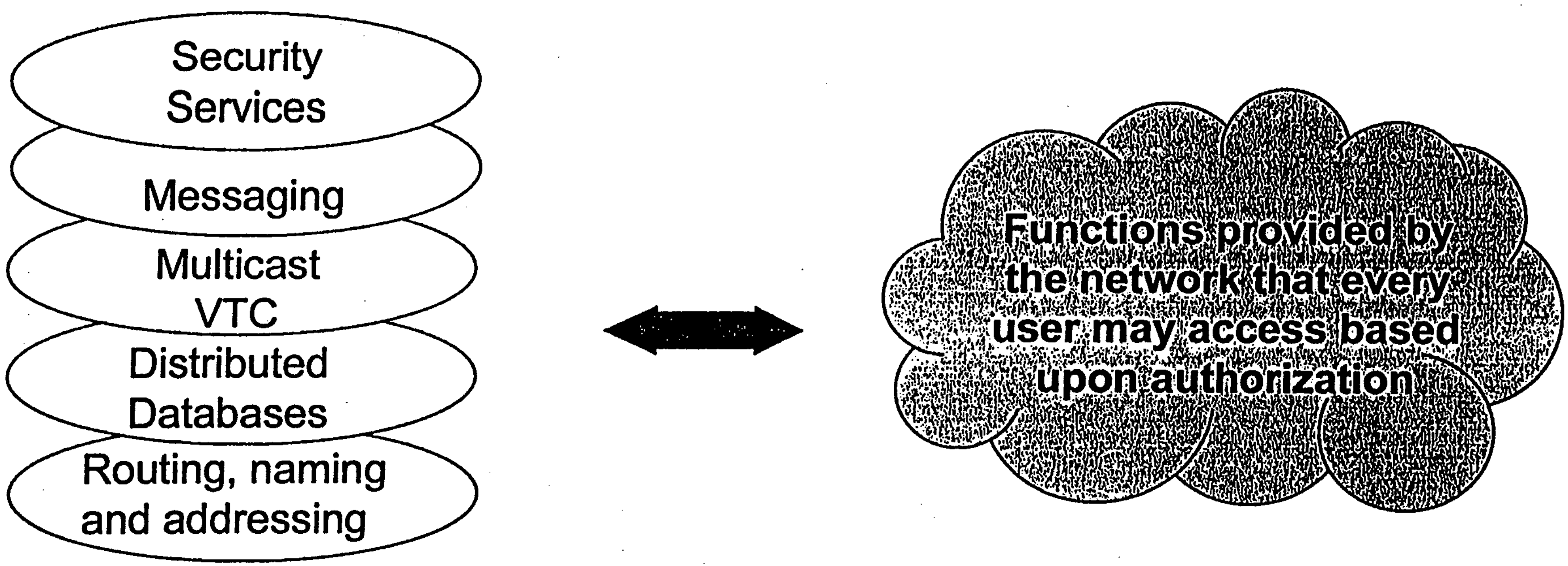
- Supports Mobile/Flexible CPs
- Provides Wireless TOC Capability
- Provides Multilevel Security
- Provides Multicast VTC



United States Army Signal Center

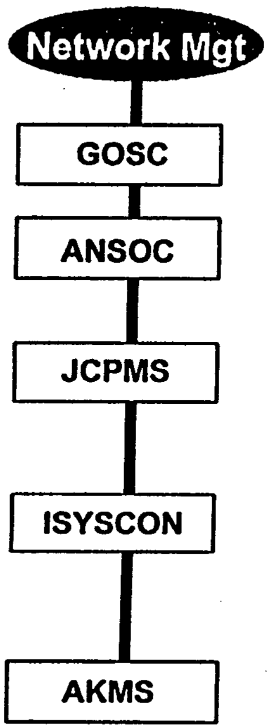
Why Invest in Network Services

Allows the Warfighter to seamlessly exchange information across security, echelon, and application software/system boundaries to accomplish the mission.



United States Army Signal Center

Network Management



Global Operations Security Center: DISA is proponent.

Army Network and Systems Operations Center: ASC is proponent.

Joint Communications Planning and Management System: Worldwide staffing of ORD completed Mar 97. CG signed 4 Apr 97. Forwarded to TRADOC on 11 Apr 97. TRADOC sent to Joint Staff on 18 Apr 97.

Integrated System Control: ROC 2 March 90; UFD 11 Jan 94; ACUS Modernization Plan approved 15 Aug 96; ISYSCON V4 (a.k.a. NMTB2) in concept exploration stage managing the Tactical Internet in TF XXI AWE Mar 97; IOTE Aug/Sep 97; MS III decision Jan 98.

Army Key Management System: AKMS DOTSP completed Oct 95; OTRR # 2 scheduled for 26 Jun 97; OTRR # 3 scheduled for 24 Aug 97; IOTE 25 Aug 97; MS III decision Jan 98.

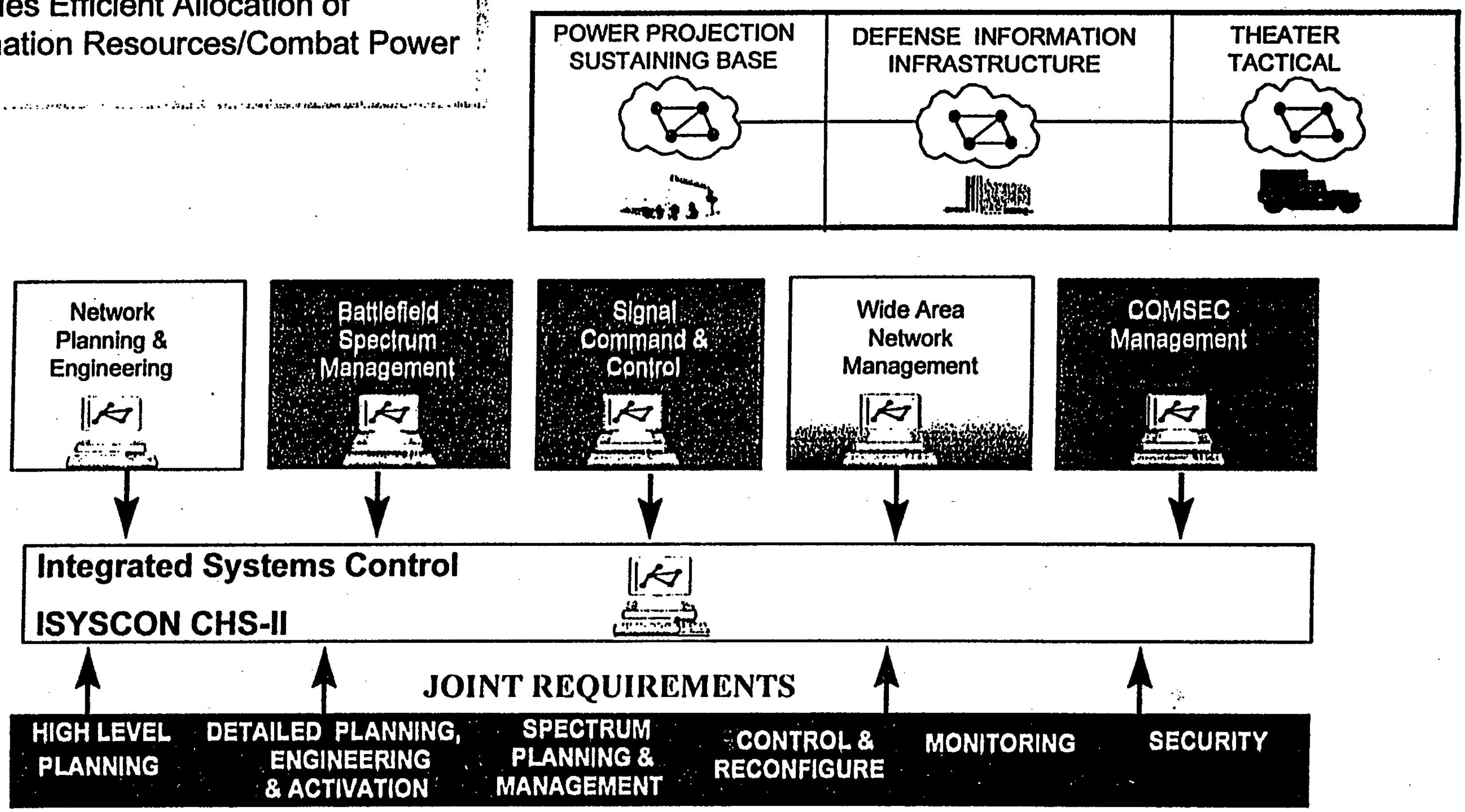
United States Army Signal Center

Network Management

Warfighting Capabilities:

- Electronic Network Management Un-Burdens the User
- Provides Efficient Allocation of Information Resources/Combat Power

All environments need a common relevant picture for network management while retaining decentralized control at the appropriate echelon



United States Army Signal Center

ACRONYM LIST

ABBREVIATIION	FULL TITLE
AAN	Army After Next
ABCCC	Airborne Command and Control Center
ACN	Airborne Communications Node
ARFOR	Army Forces
ATM	Asynchronous Transfer Mode
BOS	Battlefield Operating Systems
C4I	Command, Control, Communications, Computers and Intelligence
CDMA	Code Division Multiple Access
CNR	Combat Net Radio
DEW	Directed Energy Weapons
DISA	Defense Information Systems Agency
DOD	Department of Defense
GBS	Global Broadcast Service
HAE	High Altitude Extended Endurance
HEMP	High Altitude Electromagnetic Pulse
HTML	Hyper Text Markup Language
IDSN	Integrated Services Digital Network
IPs	Internet Protocols
JROC	Joint Requirements Oversight Council
JTF	Joint Task Force
JV2010	Joint Vision 2010
JWID	Joint Warrior Interoperability Demonstration
MAE	Medium Altitude Long-Endurance
PCS	Personal Communications Service
POM	Program Objective Memorandums
QDR	Quadrennial Defense Review

ACRONYM LIST (Continued)

ABBREVIATIION	FULL TITLE
SATCOM	Satellite Communications
SSG	Special Study Group
UAV	Unmanned Aerial Vehicle
UHF	Ultra-High Frequency
WIN	Warfighter Information Network

ENDNOTES

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