Fact Sheet

Defense Advanced Research Projects Agency

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Fact Sheet: Future Combat Systems Communications Program

The Defense Advanced Research Projects Agency (DARPA) and the U.S. Army have selected 16 contractors to develop and demonstrate state-of-the-art communications technology as part of the Future Combat Systems (FCS) Communications program. FCS Communications is one of the key supporting technology programs of the DARPA/Army Future Combat Systems collaborative demonstration.

The FCS concept envisions an overriding need for high data-rate and low-latency communications to support real-time fire control and robotic missions. Since FCS will operate in a hostile electromagnetic environment, its communications system must be robust against jamming and be difficult to detect. DARPA plans to meet those opposing constraints by using a multi-tiered, mobile, ad-hoc network with directional antennas at low frequencies (e.g., frequencies used by the Joint Tactical Radio System (JTRS)) and highly directional antennas at high frequencies (above microwave bands). Providing the ability to transmit large amounts of data quickly while avoiding jamming and detection will require significant advancements in transmitters, receivers, and directional antenna technology, as well as the use of mobile, ad-hoc networking techniques with directional antennas.

The FCS Communications program is pursuing a two-pronged approach. The 16 contractors listed here will develop advanced communications technologies. In addition, the program has a systems integration and demonstration component to design a communications system and demonstrate wireless networking between mobile platforms (manned and robotic) using directional antennas. Multiple contractors will participate in the first six months of the integration and design effort, but only a single contractor will be chosen to field the demonstration of a portion of the communications infrastructure of a single notional FCS cell. The program will conduct the demonstration by April 2003.

Eleven companies are receiving new contracts to develop advanced communications technologies. Each received a contract ranging between $350,000 to $1,500,000 for an initial 12-month effort. The program can choose to extend contracts for an additional 20 months, depending on initial results.

- BAE Systems (Nashua, N.H.) is developing a low band architecture system to provide a suite of directional antennas for low probability of interception and anti-jam. This work is developing an ultrawideband, co-located, meanderline antenna and associated siting (platform integration) techniques. A low-band resource manager will be developed to control the beam and null positions created by the antenna suite.

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- BAE Systems (Nashua, N.H.) is developing a high-band antenna. BAE is working on variable transmission lines and piezoelectric control to support the development of a circularly polarized, 38-gigahertz, high-directivity array antenna. Their design, which eliminates individual element control devices, is based on a two-dimensional scan and provides multiple, single-beam apertures.
- BAE Systems (Nashua, N.H.) is developing high-efficiency, high-band transmitters. BAE is developing high-efficiency, 0.1-micrometer, metamorphic High Electron Mobility Transistors (HEMT) power microwave millimeter-wave integrated circuits (MMICs) using indium phosphate HEMT technology on a gallium arsenide substrate. This technology is a key enabler for next-generation, millimeter-wave, solid-state transmitters.
- Scalable Network Technology Inc. (Los Angeles, Calif.) is developing a high-fidelity, scalable, network simulation based on the QualNet tool that allows detailed modeling of each layer of the communications stack and has demonstrated the feasibility of real-time simulation of networks with hundreds of wireless nodes. Scalable Network Technology will develop enhanced propagation and antenna models to support directional transmissions and channel models with improved efficiency.
- Rockwell-Collins (Cedar Rapids, Iowa) is developing a high-band, 35-gigahertz, beam-former, active-array antenna. This array is composed of waveguide modules with integrated stripe electromagnetic crystal phase-shifter walls. These high-impedance surfaces enable efficient, quasi-optic amplification (e.g., 2.5 watts at 35 gigahertz) and beam-steering. The modules are stacked into an array to scale power and increase directivity. The arrays being developed can act as either power amplifiers or low-noise amplifiers.
- Rockwell-Collins (Cedar Rapids, Iowa) is developing a single Orthogonal Frequency Division Multiplexing (OFDM) digital receiver architecture. The objective is to develop a broadband waveform that meets the multi-rate FCS communications requirements and is expandable, reconfigurable, and JTRS-compliant. The use of orthogonal frequency division multiplexing provides multiple bits per carrier in benign channel conditions and multiple carriers per bit for stressed channel conditions.
- Raytheon (Falls Church, Va.) is addressing FCS low-band communications. Raytheon will develop and demonstrate a smart, reconfigurable antenna, a JTRS-compliant Ultra Comm software-defined radio, and an adaptive vector OFDM high-data-rate waveform. Development goals for this 20 to 3000 megahertz radio include an aggregate space-time forward error correcting gain of 60 decibels and an antenna null depth of 30 decibels, both at L-band.
- Raytheon (Fullerton, Calif.) is developing bandwidth-efficient networking with beam forming antennas. Raytheon will develop network and media access control (MAC) protocols that exploit directional antennas and node-tracking data and will demonstrate ad-hoc networking with directional antennas in simulation and prototypes. Raytheon will investigate techniques for rapid beam-forming and denial of service prevention.
- TRW (Carson, Calif.) is developing a mobile, wideband, millimeter-wave radio. The radio is based on upgrades to an existing code division multiple access (CDMA) radio, and to a 38-gigahertz MMIC transceiver. The radio features 100 megabits per second, peer-to-peer

communication and extreme anti-jam, low probability of intercept and low probability of deception.

- BBN (Cambridge, Mass.) is developing a networking technology called Utilizing Directional Antennas for Ad-hoc Networking (UDAAN). The UDAAN system will develop network and MAC layer protocols for the exploitation of directional antennas to provide network performance improvements in capacity, latency, robustness and security. BBN will also develop and demonstrate a suite of interacting but separable modules using simulation.
- Lucent Technologies (Whippany, N.J.) is developing Bell Labs LAyered Space Time Processing (BLAST) for FCS Communications. BLAST will be designed to provide high-data-rate communications using non-line-of-sight links in heavy scattering environments with mobile end points. The effort will also attempt to reduce the probability of detection through both lowering the symbol rate and use of spread spectrum techniques as well as supporting adaptive array spatial nulling for interferers.

Three projects already funded under the DARPA Special Projects Office Reconfigurable Aperture (RECAP) program received additional funds to enhance their existing RECAP projects as part of the overall FCS Communications technology effort.

- Titan/Atlantic Aerospace Corporation (AAEC) (Greenbelt, Md.) is developing a UHF array over a high impedance surface. This project is developing a two by two array of Artificial Magnetic Conductor-backed broadband antennas in a compact, low-profile package. This antenna will cover 225 to 450 megahertz with a peak gain of 9 dBi.
- Georgia Institute of Technology Research Institute (GTRI) (Atlanta, Ga.) has been funded for micro-switched percolating reconfigurable aperture development. GTRI will design, fabricate, and test a single-feed low-frequency (800 megahertz to 2.5 gigahertz) aperture using a GTRI RECAP architecture.
- Ball Aerospace (Broomfield, Colo.) is developing a polymide microelectromechanical systems (PMEMS) two-dimensional scanned surface technology antenna. This development uses an active lens with imbedded MEMS (PMEMS) and steers the beam through phase manipulation. This approach reduces the number of active components by more than 16, has a low profile, and is low loss, lightweight; and low cost.

Two projects already funded within the DARPA Advanced Technology Office received additional funds to enhance their existing projects as part of the overall FCS Communications technology effort.

- Motorola (Scottsdale, Ariz.) is developing high-capacity, low probability of detection technologies. These technologies will provide low probability of detection communications with data rates of greater than one megabit per second while maintaining anti-jam margins of more than 60 decibels rejection of narrowband signals and processing gains ranging from 20 to 40 decibels depending on data-rate.
- Ipitek (Carlsbad, Calif.) is developing a low-cost, radio-frequency lightwave circuit (RFLIC) low phase-noise millimeter-wave source using 1550 nanometer technology. The goal is to develop a 38-gigahertz polymer RFLIC millimeter-wave transmitter based on a single chip, optical-signal processing design.

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This fact sheet will be updated in August 2001 to include the names of companies chosen for the systems integration and demonstration effort. Additional information on the FCS Communications program is available on the Web at http://www.darpa.mil/ato/solicit.htm.

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