UNITED STATES SPECIAL OPERATIONS COMMAND
16.1 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

Introduction:

The United States Special Operations Command (USSOCOM) seeks small businesses with strong research and development capabilities to pursue and commercialize technologies needed by Special Operations Forces (SOF). The USSOCOM Program Executive Officers (PEOs) submitted the topics to the USSOCOM SBIR Program Manager (PM) as topics that may transition to an acquisition Program of Record or Concept of Operation. In turn, the USSOCOM SBIR PM submitted the topics to the Department of Defense (DoD) for the DoD 16.1 SBIR solicitation.

A thorough reading of the "U.S. Department of Defense Small Business Innovation Research (SBIR) Program: Program Solicitation FY 16.1" prior to reading these USSOCOM instructions is highly recommended. These USSOCOM instructions are additive to the DoD guidance; i.e., designed to tailor or enhance certain aspects of the solicitation to meet or explain certain unique aspects of the USSOCOM SBIR program.

Contact with USSOCOM:

During the pre-release period of this DoD 16.1 SBIR solicitation, any technical inquiries must be submitted in writing through sbir@socom.mil, rather than made directly to the topic authors as specified in Section 4.15.c. of the DoD 15.1 SBIR Program Solicitation instructions. All inquiries must include the topic number in the subject line of the e-mail. During the solicitation open period, all questions must be submitted through the SBIR Interactive Topic Information System (SITIS) at https://sbir.defensebusiness.org/sitis/. See Section 4.15.d of the DoD 15.1 SBIR Program Solicitation instructions for additional information on SITIS. During the source selection period, e-mail is the only method of communication that will be used by the Government Contracting Officer to notify the submitter/proposer if they have or have not been selected for an award.

Site visits will not be permitted during the pre-release and open stages of the solicitation.

Phase I and Phase II Proposal Submission:

USSOCOM will only accept Phase I proposals for the topics included in this USSOCOM solicitation, and select and fund for a Phase I award only those proposals that are most likely to succeed in meeting a USSOCOM need.

Small business concerns awarded a Phase I contract may choose to submit a Phase II proposal not later than thirty (30) calendar days following the end of the Phase I contract. Submission of a Phase II proposal is not included as part of the Phase I contract.

Potential offerors shall submit all Phase I and Phase II proposals in accordance with the DoD Program Solicitation at https://sbir.defensebusiness.org (Section 5.0 Phase I Proposal and Section 7.0 Phase II Proposal) with one exception. That is, offerors must complete the cost volume using the Cost Proposal form posted on the USSOCOM section of the submission site. The Cost Proposal information (in PDF format) shall be appended to and submitted with the Technical Volume. The Technical Volume shall not exceed 20 pages. Proposals with a Technical Volume exceeding 20 pages will not be evaluated. The

appended Cost Proposal does not count toward the 20 page Technical Volume limit, nor does the Company Commercialization Report.

Phase I Evaluation:

USSOCOM conducts a formal source selection process to determine which offerors should be awarded Phase I SBIR contracts. USSOCOM evaluates Phase I proposals using the evaluation criteria specified in Section 6.0 entitled "Phase I Evaluation Criteria" of the DoD 16.1 SBIR Solicitation.

Informal Feedback: A non-selected offeror shall make a written request for feedback within 30 calendar days of receipt of notification of non-selection. USSOCOM will provide informal feedback in lieu of a debriefing. USSOCOM will provide informal feedback within 30 calendar days of an offeror's written request. (These component-unique instructions are in accordance with paragraph 4.10, entitled "Debriefing", of the DoD 16.1 SBIR solicitation.)

Phase I Awards:

USSOCOM's SBIR Program is small compared to most other participating DoD Components and, on average, awards three Phase I contracts per topic. The maximum amount of SBIR funding for a Phase I award is $150,000 and the period of performance is typically six months. USSOCOM does not include options in the resulting Phase I SBIR contracts. Phase I SBIR contracts are Firm Fixed Price contracts.

Phase I Kick-Off and Out-Brief Meetings: USSOCOM conducts Kick-Off and Out-Brief meetings during the Phase I period of performance. Firms selected for a Phase I SBIR contract shall have the ability to participate in the Kick-Off and Out-Brief meetings via electronic media mutually agreed upon by the firm and the Contracting Officer Representative.

Phase II Evaluation:

Each contractor's Phase II proposal received will be assessed as an independent technology pursuit, and will be judged on (1) how well it meets USSOCOM requirements, and (2) considerations of programmatic risk. Factors to determine programmatic risk include but are not limited to:

- The contractor's performance during Phase I
- Scientific and technical merit and feasibility
- Contractor's Qualifications
- Commercialization potential (based on the Commercialization Achievement Index and the Business Plan the company submitted during Phase I)

Phase II Awards:

The timing of selection for a Phase II award will be dependent upon USSOCOM's current requirements and available resources.

A Phase II award typically has a period of performance between 12 to 24 months and an award amount of approximately $750,000 to $1,000,000. USSOCOM may elect to increase or decrease the Phase II award amount when it is deemed to be in its best interests. Proposals should be based on realistic cost and time estimates, and not on the maximum time (months) and dollars budgeted. In preparing the proposal, offerors should consider that USSOCOM's workload and operational tempo will preclude extensive access to Government and military personnel beyond established periodic reviews.

The Federal Acquisition Regulation mandate to compete federal procurements is satisfied during the Phase I source selection process. Only those companies awarded Phase I contracts are allowed to submit Phase II proposals.

USSOCOM considers each Phase I feasibility study as a separate and distinct study that does not compete against each other. The feasible solutions that result from the Phase I studies are considered technology options that can be applied when needed to solve SOF capability shortfalls. Phase I feasibility options not immediately pursued after the conclusion of Phase I may move forward to the Phase II demonstration effort to satisfy future capability shortfalls.

USSOCOM SBIR Program Point of Contact: Inquiries concerning the USSOCOM SBIR Program should be addressed to sbir@socom.mil.

USSOCOM SBIR 16.1 Topic Index

USSOCOM SBIR 16.1 Topic Descriptions

SOCOM16-001 TITLE: Alternative or Redundant Global Positioning System Navigation

TECHNOLOGY AREA(S): Air Platform, Electronics, Information Systems, Sensors

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop either an alternate means or a redundant Global Positioning System (GPS) capability for Special Operations Forces (SOF) aircraft to acquire and maintain accurate timing, position and navigation.

DESCRIPTION: Some of the issues with the current GPS include blind spots as well as spoofing and jamming of the GPS signal. Additionally, many GPS satellites are outside of their designed lifetime and are likely to become less reliable in the future. Finally, it is uncertain whether current budget cuts will allow the funding needed to launch new GPS satellites. An innovative and inexpensive means to acquire position, navigation and timing are required to ensure operational missions can continue without a GPS signal. Inertial systems in some of the SOF platforms provide a redundancy to GPS but they suffer from integration drift caused by small errors in the measurement of acceleration and angular velocity.

PHASE I: The overall objective of a USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a technology need. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

The specific objective of this Phase I is to conduct a feasibility study to develop an innovative alternative to the current GPS to acquire position, navigation and timing or a redundant GPS capability. The solution shall:

- be backward compatible to ensure currently acquired civil and military user equipment can continue to perform to the same or better level than it does today (Dual-Frequency P(Y)-Code Accuracy Standard is less than or equal to 5.9 meters at 95% Global Average User Range Error during normal operations over all age of data). Backward compatibility preserves legacy capability while transitioning to a new or a redundant system.
- be sound and secure to resist blind spots, jamming and spoofing.
- have near real-time command and control (Internet Protocol Network (crosslinks).
- have position and time transfer integrity where integrity is a measure of the trust that can be placed on the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and valid warnings to the user (alerts) when the system must not be used for the intended operation.
- have availability of time transfer accuracy where over a 24-hour period the predicted time transfer accuracy meets or exceeds a specified value. Precise time is essential for time synchronization with numerous military and civil systems (e.g., military communication systems, cell phone systems, international banking systems, electric power grids).
- be net ready and have the ability to enter and be managed in the network, and exchange data in a secure manner to enhance mission effectiveness. The system shall continuously provide survivable, interoperable, secure, and operationally effective information exchanges to enable a Net-Centric military capability.
- be reliable such that it should have a 95% probability of completing 5 sorties without mission degrading.

- be inexpensive to acquire and have low ownership (life cycle) costs.

PHASE II: Develop a prototype that demonstrates that the innovative alternative or redundant GPS technology meets the requirements specified in the above "Phase I" paragraph. The prototype will be assessed in a comparable environment where SOF operate to ensure the technology is suitable for its intended use.

PHASE III DUAL USE APPLICATIONS: USSOCOM, other DoD Components, Federal Agencies and commercial businesses that currently use the Global Positioning System.

REFERENCES:
1. Defense Advanced Research Projects Agency PNT project Adaptable Navigation Systems (ANS)
http://www.darpa.mil/program/adaptable-navigation-systems

2. Defense Advanced Research Projects Agency PNT project Readout (QuASAR)
http://www.darpa.mil/program/quantum-assisted-sensing-and-readout

3. GPS Precision Positioning Service (PPS) Performance Standard
http://www.gps.gov/technical/ps/2007-PPS-performance-standard.pdf

KEYWORDS: Global Positioning System, GPS, Positioning, Navigation, Timing, PNT

SOCOM16-002 TITLE: Environmentally Stable Portable Point of Care Blood Analyzer

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: Develop an environmentally stable (temperature, humidity) portable (hand-held) point of care blood analyzer device capable of conducting standard blood chemistry analysis to improve diagnostic capabilities and clinical outcomes particularly with respect to prolonged field care.

DESCRIPTION: Special Operations Forces medical providers require a handheld point of care blood analyzer device, capable of providing real-time, lab-quality results within minutes. Results of rapid point of care blood analysis accelerate clinical decision-making, and are invaluable as we focus more on prolonged field care. Current Commercially available Off the Shelf (COTS) devices are cartridge based systems where either diagnostic, calibration or quality control test cartridges require refrigeration, thereby making the devices unsuitable for SOF medics. The devices and/or cartridges are highly sensitive to environmental factors like temperature and humidity and, therefore, are not suitable in austere locations where SOF operate.

PHASE I: The overhead objective of a USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

The specific objective of this Phase I is to conduct a feasibility study to develop an environmentally stable point of care hand held blood analyzer. The analyzer shall:
- be capable of standard clinical blood analysis including but not limited to: Sodium, Potassium, Chloride, Total Carbon Dioxide (TCO2), Anion Gap, Ionoized Calcium, Glucose, Urea Nitrogen/Urea, Creatinine, Lactate,

Hemotocrit, Hemoglobin, Blood Gases (pH, pCO2, pO2).
- perform blood typing to include ABO and Rh.
- be comparable in size to currently available COTS devices and require a similar amount of blood {~ 100 micro liters (μL)} for analysis.
- be environmentally stable.
- not require refrigeration.
- not require an external power source.
- have a shelf life of a year or longer.

The feasibility study shall also:
- identify technology areas of risk to develop the device.
- identify the regulatory pathway of the device for Food and Drug Administration (FDA) approval, to include any research or clinical studies that will be required for FDA approval.
- develop point of care blood analyzer device designs that would be environmentally stable and that include all components required to conduct tests and calibration.

PHASE II: Provide and demonstrate a point of care blood analyzer prototype that meets or exceeds the requirements specified in the above paragraph entitled "Phase I". The prototype shall be capable of advancing the research and/or clinical trials required for future FDA approval.

PHASE III DUAL USE APPLICATIONS: Likely transitions include a Service Common Advanced Development effort or jointly sponsored efforts with the United States Special Operations Command (USSOCOM) and other Services. The device would also have potential commercial application to the rest of the Department of Defense, the Department of State, Disaster Response Agencies, and Non-Governmental Healthcare Agencies.

REFERENCES:
1. Gault MH1, Harding CE. "Evaluation of i-STAT Portable Clinical Analyzer in a Hemodialysis Unit". Clin Biochem. 1996 Apr;29(2):117-24.

2. Kok J1, Ng J, Li SC, Giannoutsos J, Nayyar V, Iredell JR, Dwyer DE, Chen SC. "Evaluation of Point-of-Care Testing in Critically Unwell Patients: Comparison with Clinical Laboratory Analysers and Applicability to Patients with Ebolavirus Infection". Pathology. 2015 Aug;47(5):405-9.

3. Rudolf J, Douglass J, Baron J, Lewandrowski K. "Evaluation of the i-STAT Point-of-Care Capillary Whole Blood Hematocrit and Hemoglobin: Comparison to the Siemens RAPIDLab 1200, Sysmex XE5000, and Manual Spun Hematocrit". Clin Chim Acta. 2015 Jun 15;446:37-42. doi: 10.1016/j.cca.2015.03.035. Epub 2015 Apr 7.

KEYWORDS: Blood, Analyzer, Portable, Point-of-Care

SOCOM16-003 TITLE: Next Generation Identity Management Technologies / Tools

TECHNOLOGY AREA(S): Information Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: To develop/demonstrate next generation high performance, scalable identity management technologies and toolsets to provide automated, smart analysis tools to enable rapid, concise understanding of adversaries knowledge of USSOCOM operators and assets.

DESCRIPTION: Recent headlines (see reference #1) highlight that technologies (such as: advanced internet, social media, cloud-based, data search/aggregation, crowd-sourcing, deep/dark Web, publicly available information, etc.) can be used by nefarious forces with rapid, global and asynchronous effects. Consequently, USSOCOM has a critical requirement to safeguard the identity information of Special Operations Forces and their assets from exploitation. Exploitation can be prevented through innovative technology that employs: education, policies, processes and a combination of technical systems that create, define, govern, and synchronize identity ownership and utilization. In order for USSOCOM to stay ahead of adversaries leveraging easily obtainable tools, the next generation identity management system shall be an integrated suite of scalable, high performance technologies and automated analysis tools to:

- Search, collect, filter and analyze diverse structured and unstructured data.
- Search, collect, filter and analyze native language data.
- Search, collect, filter and analyze imagery and video.
- Assess and manage risks.
- Improve search and analysis efficiency/effectiveness, and reduce data sources costs.
- Reduce data duplication, improve entity resolution, and enrich data quality/accuracy.
- Provide global/regional data collection and analysis.
- Provide full spectrum attribution management.

Current DoD efforts leverage commercial search and data aggregation tools, and the feasibility study should address how the proposed innovative technologies exceed the currently available tools and capabilities.

PHASE I: The overall objective of this USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a needed technology. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

The specific objective of this feasibility study is to determine what is in the art of the possible that satisfies the requirements specified in the above paragraph entitled “Description”.

PHASE II: Develop a prototype and conduct a scalable prototype demonstration of all critical technologies and attributes. While the demonstration may be conducted with limited number of data sources, it shall demonstrate its capability to integrate the full range of global and regional data sources. The Phase II effort shall also develop a detailed design that could eventually be developed to satisfy operational capabilities.

PHASE III DUAL USE APPLICATIONS: These technologies have dual-use applications beyond the DoD that include commercial marketing, sales and investment banking.

REFERENCES:

1. www.msn.com, 8/13/2015, “ISIS ‘hacking division’ releases details of 1400 Americans and urges attacks’ “

2. “A Comparison of Approaches to Large-Scale Data Analysis”, Madden, 2009

3. “NORMS: An Automated Tool to Perform Schema Label Normalization”, Sorrentino, Bergamaschi, 2011

4. “Privacy Games: Optimal User-Centric Data Obfuscation”, Shokri,

5. “Research on Chunking Algorithms of Data De-Duplication”, Cai, Zhang, Wang, 2012

KEYWORDS: Identity Management, Data Aggregation, Publically Available Information, Data Duplication

SOCOM16-004 TITLE: Optically Transparent Tapered Resistive Films

TECHNOLOGY AREA(S): Ground/Sea Vehicles, Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: The objective of this topic is to develop an innovative film/process that provides a tapered resistive layer across the film while remaining transparent in the Visual and Near Infrared (NIR) optical bands for use in Radio Frequency (RF) applications.

DESCRIPTION: Naval Special Warfare (NSW) needs a tapered resistive layer that remains transparent in the Visual and NIR bands for use in optically transparent structures of glass and/or polycarbonates. The performance goal for Visual Light Transmission (VLT) level is 85%. The resistive layers shall provide a continuous taper from 1 ohm/square to 377 ohms/square across a 6 inch surface span for basic marine “X” and “S” band radar frequencies. This layer shall be compliant with manufacturing techniques and processes used in other visual transparent structures (e.g. windows). Resistive layers and/or constituent materials exposed to weather shall be marinized against heavy rain and sea spray and ruggedized to withstand vibration and mechanical shock caused by wave slams, sustained while the craft is operating at 40 knots in 4 foot combined seas (which is roughly equivalent to accelerations of 10g's, 100 milliseconds, half sine wave), depending on where and how the system is mounted on the craft.

PHASE I: The overall objective of a USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a technology need. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

The specific objective of this Phase I is to conduct a feasibility study to assess what is in the art of the possible that satisfies the requirements specified in the above paragraph entitled "Description." As a part of this feasibility study, the proposers shall address all viable overall system design options including manufacturing processes.

PHASE II: Provide and demonstrate a prototype system determined to be the most feasible solution during the Phase I feasibility study on a NSW combatant-craft in a realistic environment.

PHASE III DUAL USE APPLICATIONS: This system could be used in a broad range of window designs requiring a tapered resistivity. Potential uses include heat generation in order to mitigate ice buildup.

REFERENCES:
1. Michael F. Otero and Roberto G. Rojas. “Resistive Treatment to Reduce Edge Diffraction from Large Wedge-Shaped Objects and Planar Antennas”. ElectroScience Laboratory, Department of Electrical Engineering Ohio State University, Columbus. Radio Science, Volume 32, Number 5, Pages 1745-1759, September-October 1997.

KEYWORDS: Materials, Sea Vehicles, Resistive Films

SOCOM16-005 TITLE: Wide Bandwidth High Frequency Digital Radio

TECHNOLOGY AREA(S): Electronics, Sensors

OBJECTIVE: Provide reliable, two-way, man-portable, low visibility, no intermediate infrastructure, surface-to-surface data communications within a 500 kilometer-diameter circle, delivering at least a 200 kilobits/second user data rate.

DESCRIPTION: Near-Vertical Incident Skywave (NVIS) is a variant of High Frequency (HF) {HF = 3 Megahertz – 30 Megahertz} communications that uses radio wave reflection from the ionosphere to link two or more radios on the ground within a several hundred kilometer distance from each other. However, traditional NVIS communications, based on a single, narrowband channel, are notoriously unreliable due to rapidly-changing ionosphere conditions and the many sources of HF interference. Furthermore, the size and orientation of broadband HF antennas make covert NVIS systems difficult.

PHASE I: The overall objective of a USSOCOM Phase I SBIR effort is to conduct and document the results of a thorough feasibility study to investigate what is in the art of the possible within the given trade space that will satisfy a technology need. The feasibility study should investigate all known options that meet or exceed the minimum performance parameters specified in this write up. It should also address the risks and potential payoffs of the innovative technology options that are investigated and recommend the option that best achieves the objective of this technology pursuit. The funds obligated on the resulting Phase I SBIR contracts are to be used for the sole purpose of conducting a thorough feasibility study using scientific experiments and laboratory studies as necessary. Operational prototypes will not be developed with USSOCOM SBIR funds during Phase I feasibility studies. Operational prototypes developed with other than SBIR funds that are provided at the end of Phase I feasibility studies will not be considered in deciding what firm(s) will be selected for Phase II.

The specific objective of this Phase I is to conduct a feasibility study to develop a high level design and simulate a HF NVIS waveform with antenna and related technology that:

- meets a NVIS communication at > 98% unobstructed, surface-to-surface link reliability while delivering data bandwidth of at least 200 kilobits/second.
- meets at least a 50 kilobits/second data bandwidth at >80% reliability in triple-canopy obstructed, surface-to-surface links.
- meets a Size, Weight and Power (SWaP) of Phase II systems compatible with covert, battery-powered, man-portable, and autonomous operation. The antenna is the primary element of a NVIS system required to be covert and shall be < 50 centimeters long and weigh < 2 kilograms.
- meets Phase II systems that provide seven-day endurance at a 10% duty cycle when powered from a single 384 watthours primary battery such as the Ultralife UB00032.
- designs a high-level NVIS radio system that implements this waveform and an associated engineering trade study for obtaining the major technology building blocks (including physically-small antennas) required to implement the system.
- designs and simulates a HF antenna that meets derived bandwidth and SWaP targets.

PHASE II: Develop and provide a prototype system to demonstrate that what was determined to be in the art of the possible can be brought into reality. Develop a detailed system design with all appropriate building blocks needed to implement a field-ready product that meets the performance, SWaP and endurance targets discussed above.

PHASE III DUAL USE APPLICATIONS: Field-ready radio systems are built, tested, and delivered to USSOCOM for operational test and evaluation. Other DoD components and Federal Agencies would be interested in this

technology; as would commercial industries, some of which include trucking, shipping, security, and medical.

REFERENCES:
1. HFpack website (www.hfpack.com) is an excellent source of present HF communication equipment and techniques. It also links to the Global Real Time Ionospheric foF2 Map showing the max HF frequency for NVIS communications by the hour across the globe.

2. "MIL SPEC Radio Gear: Korean War to Present Day" by Mark Francis, published by CQ Communications, Inc., September 2005.

3. "Performance Envelope of Broadband HF Data Waveforms", Eric Johnson, Klipsch School of Electrical and Computer Engineering, New Mexico State University (http://wireless.nmsu.edu/hf/papers/WBHF.pdf). A good introductory paper to the expansion of HF comms past the traditional 3kHz channel.

4. MIL-STD-188-141C titled "Interoperability and Performance Standards for Medium and High Frequency Radio Systems," released 27 December 2011. (http://hflink.com/standards/MIL_STD_188-141C.pdf), is a US DOD standard for a number of HF radio functions, features, and performance. The 141C revision introduces the increase of a single channel bandwidth up to 24kHz and defines modes for multi-channel HF radios.

5. "Revision of US Military HF Radio Standards", Eric Johnson, Klipsch School of Electrical and Computer Engineering, New Mexico State University (26 January 2012) (http://www.hfindustry.com/meetings_presentations/presentation_materials/2012_jan_hfia/presentations/04_MIL_Standards_Revision_Status- HNSON.pdf) is a look a few years back at wideband HF standards, including data rates possible with wider bandwidths up to 24kHz.

KEYWORDS: WBHF, HF, NVIS, Digital Radio, Communications, Wireless, Physically Small Antenna