OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

Intelligence ARPA (IARPA) Overview Briefing

LEADING INTELLIGENCE INTEGRATION

August 2014

Office of the Director of National Intelligence

IARPA Mission and Method

IARPA's mission is to invest in high-risk/high-payoff research that has the potential to provide the U.S. with an overwhelming intelligence advantage over our future adversaries

- **Bring the best minds to bear on our problems**
  - Full and open competition to the greatest possible extent
  - World-class, rotational, Program Managers
- **Define and execute research programs that:**
  - Have goals that are clear, measureable, ambitious and credible
  - Employ independent and rigorous Test & Evaluation
  - Involve IC partners from inception to finish
  - Run from three to five years

Office of Incisive Analysis

"Maximizing Insight from the Information We Collect, in a Timely Fashion"

Large Data Volumes and Varieties

Providing powerful new sources of information from massive, noisy data that currently overwhelm analysts.

Social-Cultural and Linguistic Factors

Analyzing language and speech to produce insights into groups and organizations.

Improving Analytic Processes

Dramatic enhancements to the analytic process at the individual and group level.

Office of Smart Collection

"Dramatically Improve the Value of Collected Data"

Novel Access

Provide technologies for reaching hard targets in denied areas

Asset Validation and Identity Intelligence

Detect the trustworthiness of others

Advance biometrics in real-world conditions

Tracking and Locating

Accurately locate HF emitters and low-power, moving emitters with a factor of ten improvement in geolocation accuracy

Office of Safe and Secure Operations

"Counter Emerging Adversary Potential to Deny our Ability to Operate Effectively in a Globally-Interdependent and Networked Environment"

Computational Power

Revolutionary advances in science and engineering to solve problems intractable with today's computers

Trustworthy Components

Getting the benefits of leading-edge hardware and software without compromising security

Safe and Secure Systems

Safeguarding mission integrity in a hostile world

How to engage with IARPA

- **Website: www.IARPA.gov**
  - Reach out to us, especially the IARPA PMs. Contact information on the website.
  - Schedule a visit if you are in the DC area or invite us to visit you.
- **Opportunities to Engage**:
  - **Research Programs**
    - Multi-year research funding opportunities on specific topics
    - Proposers' Days are a great opportunity to learn what is coming, and to influence the program
  - **"Seedlings"**
    - Allow you to contact us with your research ideas at any time
    - Funding is typically 9-12 months; IARPA funds to see whether a research program is warranted
    - IARPA periodically updates the topics of interest
  - **Requests for Information (RFIs) and Workshops**
    - Often lead to new research programs, opportunities for you to provide input while IARPA is planning new programs

Concluding Thoughts

- **Our problems are complex and truly multidisciplinary**
- **Technical excellence & technical truth**
  - Scientific Method
  - Peer/independent review
  - Full and open competition
- **We are always looking for outstanding PMs**
- **How to find out more about IARPA**:

  www.IARPA.gov
- **Contact Information**

  Phone: 301-851-7500

OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

Doing Business with IARPA

LEADING INTELLIGENCE INTEGRATION

21 August 2014

Doing Business with IARPA
Recurring Questions

- Questions and answers (http://www.iarpa.gov/index.php/faqs)
- Eligibility information
- Intellectual property
- Pre-publication review
- Preparing the proposal (Broad Agency Announcement (BAA) Section 4)
  - Electronic proposal delivery (https://iarpa-ideas.gov)
  - Organizational Conflicts of Interest (OCOI)
  - http://www.iarpa.gov/index.php/working-with-iarpa/iarpas-approach-to-oci
- Streamlining the Award Process
  - Accounting system
  - Key personnel
- IARPA funds “applied research”
- RECOMMENDATION: Read the entire BAA

Responding to Q&As

- Please read entire BAA before submitting questions
- Pay attention to Section 4 (Application & Submission Info)
- Read Frequently Asked Questions on the IARPA website @ http://www.iarpa.gov/index.php/faqs
- Send your questions as soon as possible
  - HF Geo Phase 2/3 BAA: *dni-iarpa-baa-14-05@iarpa.gov*
  - Write questions as clearly as possible
  - Do NOT include proprietary information

Eligible Applicants

- Collaborative efforts/teaming strongly encouraged
  - Content, communications, networking, and team formation are the responsibility of Proposers
- Foreign organizations and/or individuals may participate
  - Must comply with Non-Disclosure Agreements, Security Regulations, Export Control Laws, etc., as appropriate, as identified in the BAA

Ineligible Organizations

- Any organizations that have a special relationship with the Government, including access to privileged and/or proprietary information, or access to Government equipment or real property, to include:
  - Other Government Agencies
  - Federally Funded Research and Development Centers (FFRDCs)
  - University Affiliated Research Centers (UARCs)
- Are **NOT** eligible to submit proposals under this BAA or participate as team members under proposals submitted by eligible entities

Intellectual Property (IP)

- Unless otherwise requested, Government rights for data first produced under IARPA contracts will be UNLIMITED
- At a minimum, IARPA requires Government Purpose Rights (GPR) for data developed with mixed funding
- Exceptions to GPR: State in the proposal any restrictions on deliverables relating to existing materials (data, software, tools, etc.)
- If selected for negotiations, you must provide the terms relating to any restricted data or software, to the Contracting Officer

Pre-Publication Review

- For funded applied research efforts, IARPA encourages publication for peer review of UNCLASSIFIED research
- Prior to public release of any work submitted for publication, the Performer will:
  - Provide copies to the IARPA PM and Contracting Officer Representative (COR/COTR)
  - Ensure shared understanding of applied research implications between IARPA and Performers

Preparing the Proposal

- Note restrictions in BAA Section 4 on proposal submissions
  - Interested Offerors must register electronically in accordance with instructions on https://iarpa-ideas.gov
  - Interested Offerors are strongly encouraged to register in IDEAS at least 1 week prior to proposal “Due Date”
  - Offerors must ensure the version submitted to IDEAS is the “Final Version”
  - Classified proposals: Contact IARPA Chief of Security using the contact info provided in the BAA
- BAA format is established to answer most questions
- Check FBO for amendments and IARPA website for Q&As
- BAA Section 5 – Read Evaluation Criteria carefully (e.g. “The technical approach is credible, and includes a clear assessment of primary risks and a means to address them”)

Preparing the Proposal (BAA Sect 4)

- Read IARPA's Organizational Conflict of Interest (OCI) policy: http://www.iarpa.gov/index.php/working-with-iarpa/iarpas-approach-to-oci
- See also eligibility restrictions on use of Federally Funded Research and Development Centers, University Affiliated Research Centers, and other similar organizations that have a special relationship with the Government
  - Focus on possible OCIs of your institution as well as the personnel on your team
  - See Section 4: It specifies the non-Government (e.g., SETA, FFRDC, UARC, etc.) support we will be using. If you have a potential or perceived conflict, request waiver as soon as possible

Organizational Conflict of Interest (OCI)

- If a prospective offeror, or any of its proposed subcontractor teammates, believes that a potential conflict of interest exists or may exist (whether organizational or otherwise), the offeror should promptly raise the issue with IARPA and submit a waiver request by e-mail to the mailbox address for this BAA at *dni-iarpa-baa-14-05@iarpa.gov*
- A potential conflict of interest includes but is not limited to any instance where an offeror, or any of its proposed subcontractor teammates, is providing either scientific, engineering and technical assistance (SETA) or technical consultation to IARPA. In all cases, the offeror shall identify the contract under which the SETA or consultant support is being provided
- Without a waiver from the IARPA Director, neither an offeror, nor its proposed subcontractor teammates, can simultaneously provide SETA support or technical consultation to IARPA and compete or perform as a Performer under this solicitation

Streamlining the Award Process

- Cost Proposal – we only need what we ask for in BAA
- Approved accounting system needed for Cost Reimbursable contracts
  - Must be able to accumulate costs on job-order basis
  - DCAA (or cognizant auditor) must approve system
  - See http://www.dcaa.mil, “Audit Process Overview - Information for Contractors” under the “Guidance” tab
- Statements of Work (format) may need to be revised
- Ensure that “Key Personnel” meet expectations of time devoted to the project; note the Evaluation Criteria requiring relevant experience and expertise
- Following selection, Contracting Officer may request your review of subcontractor proposals

IARPA Funding

- IARPA funds applied research for the Intelligence Community (IC)
  - IARPA cannot waive the requirements of Export Administrative Regulation (EAR) or International Traffic in Arms Regulation (ITAR)
  - Not subject to DoD funding restrictions for R&D related to overhead rates
- IARPA is <u>not</u> DoD

Disclaimer

- This is applied research for the Intelligence Community
- Content of the Final BAA will be specific to this program
  - The Final BAA is being developed
  - Following issuance, look for Amendments and Q&As
  - There will likely be changes
- The information conveyed in this brief and discussion is for planning purposes and is subject to change prior to the release of the Final BAA

QUESTIONS ?

OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

High Frequency Geolocation (HFGeo) Smart Collection Office

LEADING INTELLIGENCE INTEGRATION

Chris Reed

HFGeo Phase 2 and 3 Proposers' Day Briefing

August 21, 2014

Agenda

8:00 – 8:30 am	*Check-in*	
8:30 – 8:40 am	*IARPA Overview & Remarks*	Dr. Jinendra Ranka Deputy Director Office of Smart Collection
8:40 – 10:00 am	*UNCLASSIFIED HFGeo Program Overview*	Dr. Chris Reed Program Manager
10:00 – 10:20 am	*Contracting Officer Remarks*	Mr. Tarek Abboushi IARPA Acquisitions
10:20 – 11:00 am	*Q&A Session*	Dr. Chris Reed Program Manager
11:00 – 11:15 am	Break	
11:15 – 11:45 am	*CLASSIFIED HFGeo Program Overview*	Dr. Chris Reed Program Manager
11:45 – 12:15 pm	*Q&A Session*	
12:15 – 1:00 pm	*No Host Lunch*	
1:00 – 4:00 pm	*UNCLASSIFIED Capability Briefings & Informal Teaming Discussions*	Non-Government Personnel Only

Outline

- **Introduction**
  - **Proposers' Day goals**
  - **Program Overview**
- **Technical Challenge**
- **Phase 1 Results**
- **Metrics and Programmatics**
- **Administrative**

Disclaimer

- **This presentation is provided solely for information and planning purposes**
- **The Proposers' Day Conference does not constitute a formal solicitation for proposals or proposal abstracts**
- **Nothing said at Proposers' Day changes the requirements set forth in a BAA**
- **BAA supersedes anything presented or said at the Proposers' Day**

Proposers' Day Goals

- **Familiarize participants with IARPA's interest in HFGeo system integration and demonstration**

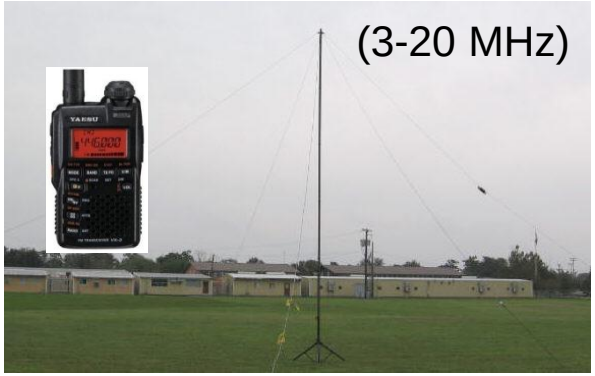
- **Please ask questions & provide feedback; this is your chance to alter the course of events**

Schedule

- **Once the BAA is released, technical questions can only be answered in writing on the program website**
- **Direct security or classified questions to IARPA C/Security Terry Gillum at 301-851-7580**
- **Proposals expected to be due 60 days after the BAA is released**

HFGeo – Geolocation of HF emitters

High-Frequency Transmitter



Graphic from: www.amazon.com and www.hamuniverse.com

1-3 hop propagation

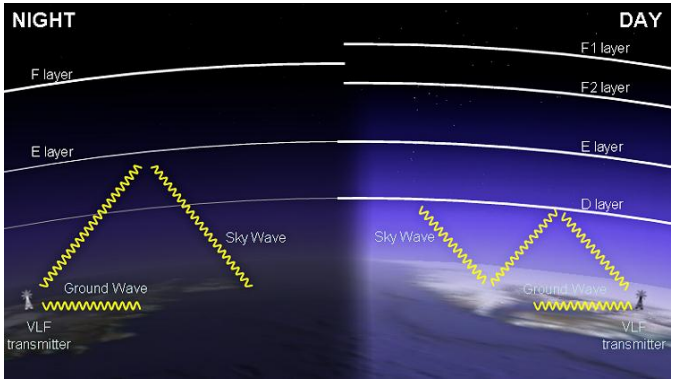
Geolocate

Large error

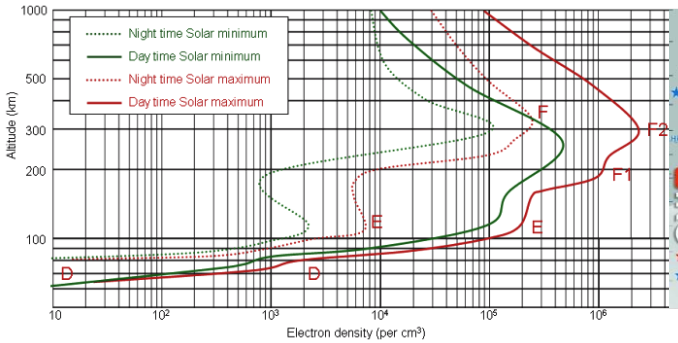
HF Receiver

Graphic from: http://en.wikipedia.org/wiki/USASA_Field_Station_Augsburg

Limited by background noise/interference and ionospheric characterization



Graphic from: Sudden Ionospheric Disturbances Monitoring Station A118



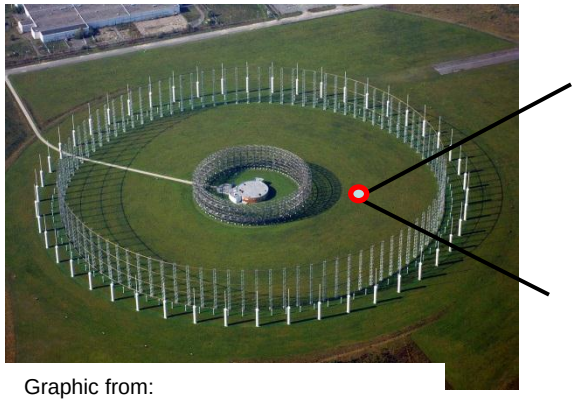
Graphic from: Sudden Ionospheric Disturbances Monitoring Station A118

Graphic from: umlcar.uml.edu/stationmap.html

HFGeo Program Goals

Phase 1

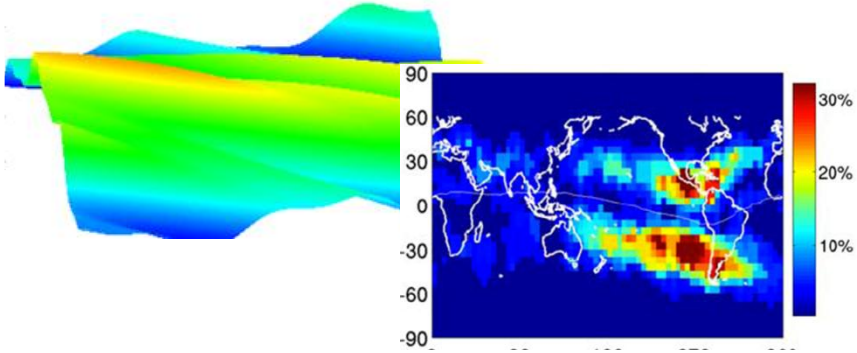
Processing Algorithms and Vector Sensors Phase 1A



Graphic from: http://en.wikipedia.org/wiki/USASA_Field_Station_Augsburg

1m x 1m x 2m

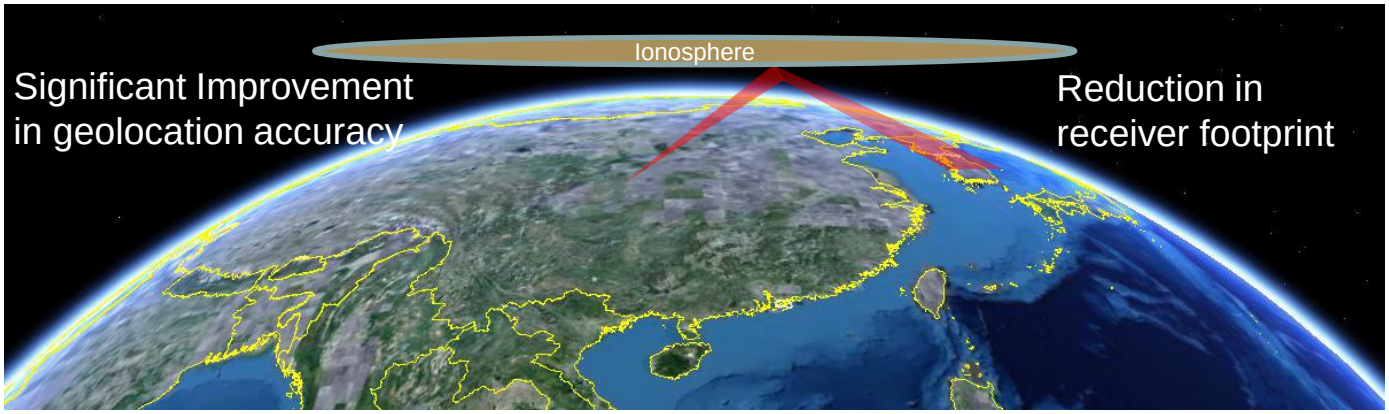
Ionosphere measurements and models – Phase 1B



Right graphic from: Park, et. al., Magnetic signatures of medium-scale traveling ionospheric disturbances as observed by CHAMP, J. Geophys. Res., 2009

Phase 2/3

System integration and field test



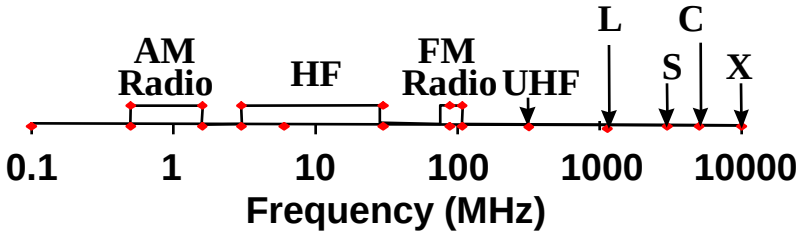
HFGeo Program Phases

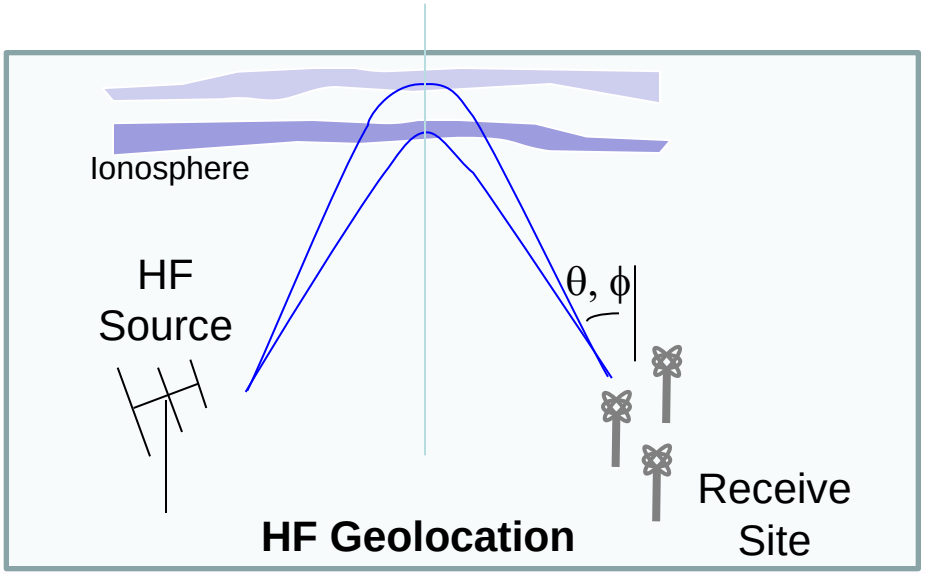
Phase Period	Purpose	Goal
Phase 1A (Complete)	Enabling Technology	HF Sensor and advanced signal processing
Phase 1B (In Progress)	Enabling Technology	Ionospheric measurement and modeling
Phase 2 (18 months)	Integrated Application	• Completely integrated prototype with antennas, signal processing, and ionospherically-informed geolocation • Non-realtime field test
Phase 3 (15 months)	Real-time application	Real-time implementation, performance improvements, and field test

This conference addresses Phases 2 and 3

Single Site Location (SSL)

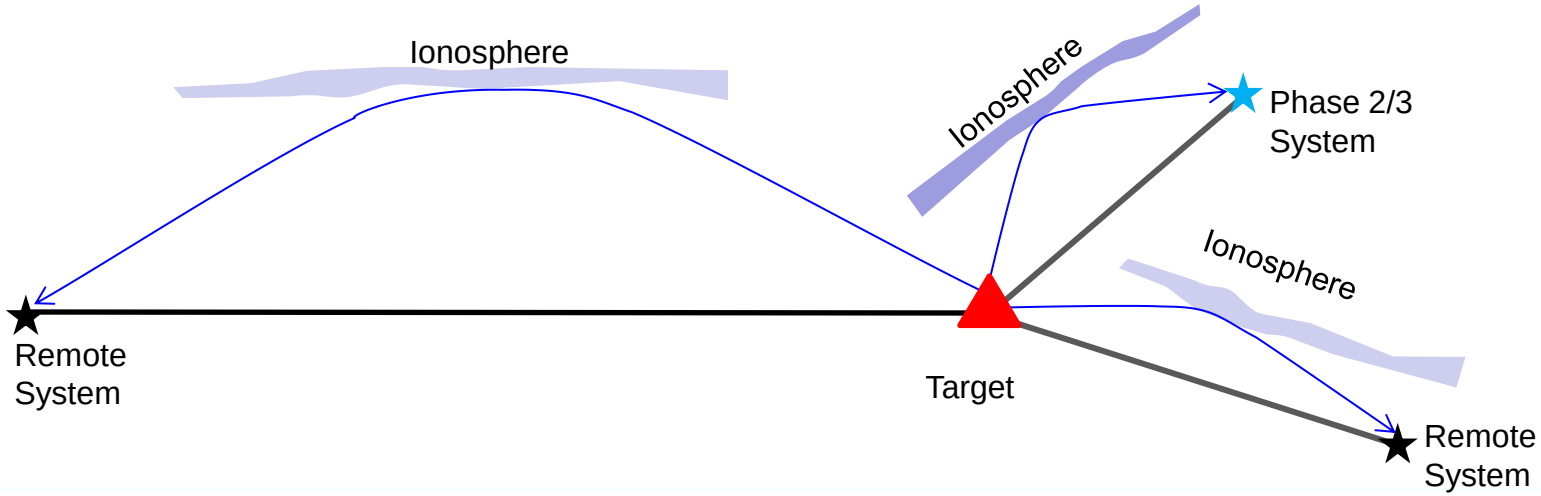
- Accurate single-site HF geolocation has long been a signal interception goal
- SSL relies on azimuth and elevation measurements at the receive site
- The measured angles are back-propagated through an ionospheric model to obtain a location on the ground
- Accurate SSL requires calibrated sensor systems, effective signal processing, and precise understanding of the dynamic ionosphere





Multiple Site Location (MSL)

- Accurate multiple-site HF geolocation has also long been a signal interception goal
- Traditional methods for HF/VHF/UHF
  - Multilateration from receive sites that each estimate azimuth Angle of Arrival (AoA)
  - Best fit to measurements of Time Difference of Arrival (TDoA)
- Ionospheric information does not inform traditional MSL

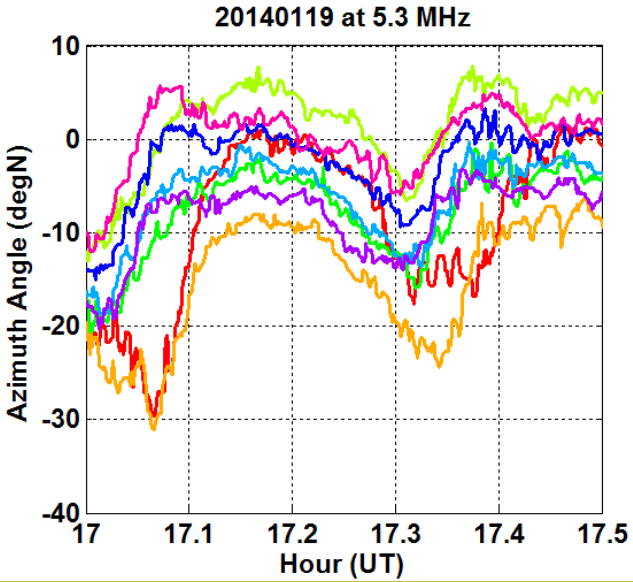


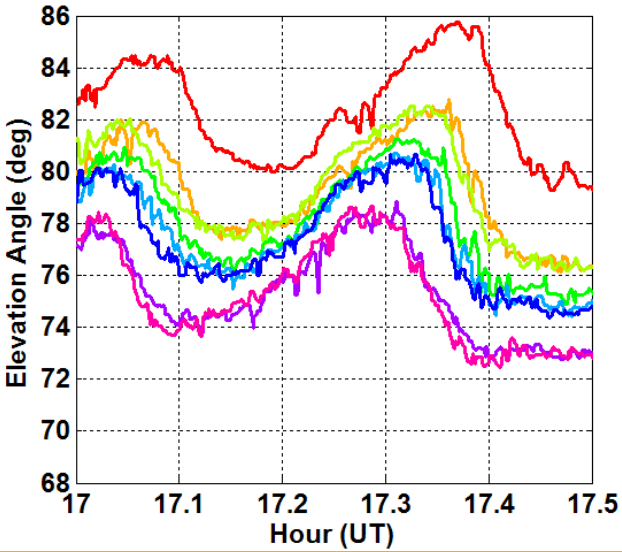
Outline

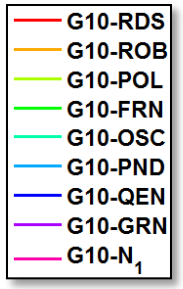
- Introduction
- Technical Challenge
- Phase 1 Results
- Metrics and Programmatics
- Administrative

Challenge of Skywave Geolocation

- Results below show azimuth and elevation AoA over time during an active ionosphere
  - Data from January 19, 2014 at White Sands Missile Range (WSMR)
- These rapid changes in observed AoA would seriously degrade geolocation accuracy, especially for short duration transmitters







9 transmit sites ~100km from receive system

Phase 1A Lessons

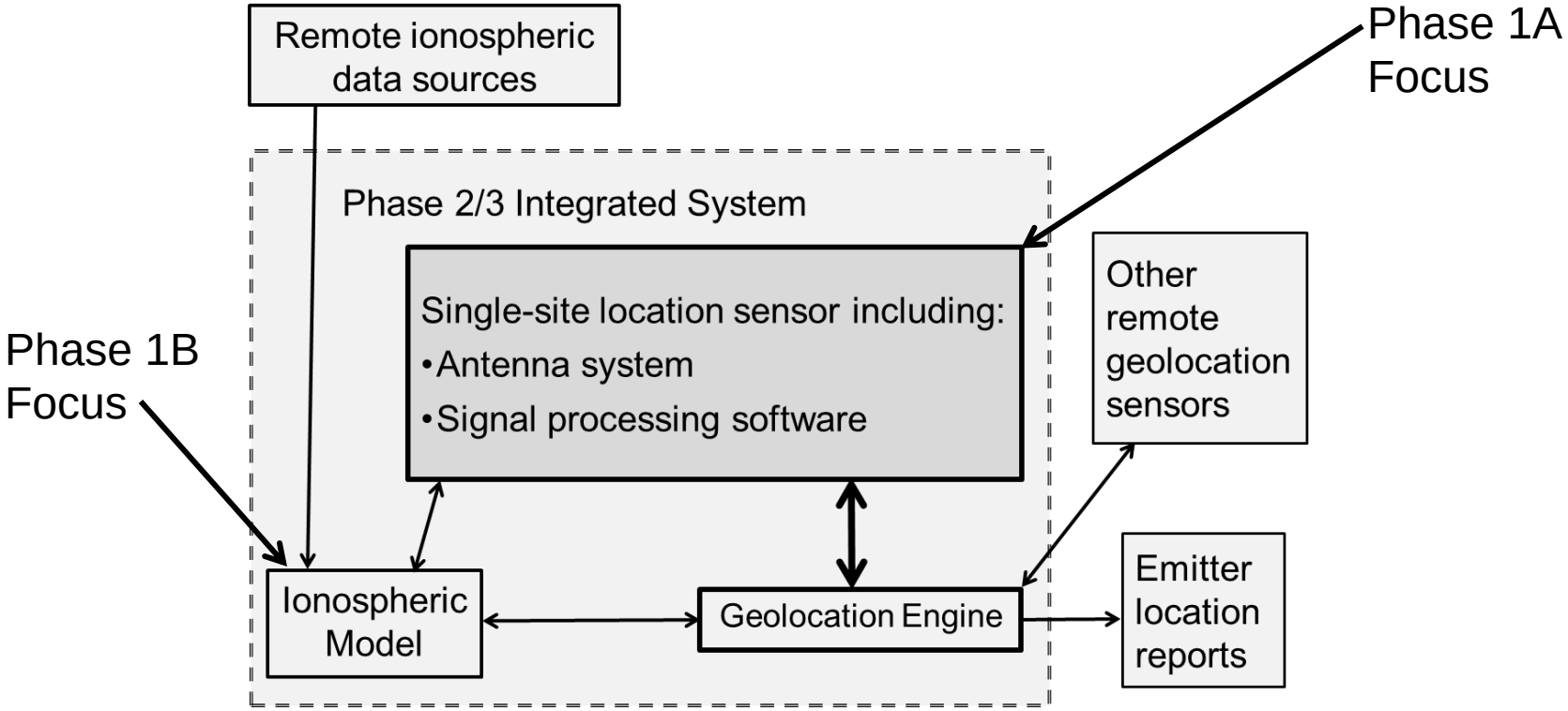
- Phase 1A developed key signal processing and vector sensor antenna technology that was demonstrated using simulated and live data
- The Phase 1A signal processing results were not demonstrated on the performer Phase 1A antenna, so full integration was not attained
- In-situ calibration was limited to government-provided antenna and signal sources, and the extent of the calibration technical challenge was not highlighted until later in the program
- Although there was some success on challenging cases, the solutions did not robustly estimate elevation and azimuth AoA for multi-mode skywave signals under a variety of conditions
- AoA estimates from large reference array were not available quickly enough to identify algorithm improvements
- The Phase 1A performers will have additional time to talk about their solutions during the afternoon session

Phase 1B Lessons So Far

- Phase 1B collected a comprehensive set of mid-latitude data for use in characterization of the ionosphere for HF propagation
- In government evaluation the Phase 1B model showed the ability to estimate received AoA by assimilating delay-doppler and ionospheric soundings
  - Computed by the nowcast, short-range metric of 90% within 2 millisteradians of measured AoA
  - Performer self-measurement also met on some during moderately active TID conditions
  - Assimilation of a dense laydown of GNSS measurements of relative Total Electron Content (TEC) was less accurate
  - In nearly all cases the Phase 1B model did much better with F-layer O-mode than X-mode
  - The Phase 1B model requires human interaction for assimilating ionospheric sounders and other sources (for example, manual correction of autoscaled ionospheric sounder traces)
- Under disturbed conditions the Phase 1B model did not meet key program metrics
  - A TID propagation model was not incorporated into the Phase 1B solution
- The Phase 1B performer will have additional time to talk about their solutions during the afternoon session

Phase 2/3 System Components

- Build, integrate, and test one sensor node
- Provide accurate SSL and MSL emitter location services



Phase 2/3 performers develop integrated hardware and software solutions that include the sensor equipment for a single receive site and a geolocation function

Expected Technical Developments: Sensors and Signal Processing

- Field deployable antenna solutions
  - Small, easy to setup antennas provide greatest mission flexibility
  - Can trade off small size for signal-to-noise ratio
  - In-situ calibration procedures that enable accurate AoA
- Skywave propagation mode separation
  - Antenna solutions and signal processing that exploits polarization
- Antenna and Array Calibration Techniques
  - In-situ calibration procedures that enable accurate AoA, including self-calibration, emitters of opportunity, and local sources (if needed)
- Signal association
  - A primary challenge of multi-site geolocation is the ability to ensure all sites are hearing the same emitter
  - Single-site geolocation can take advantage of time history to improve geolocation accuracy if they have confidence it is the same emitter

Expected Technical Developments: Ionospheric Modeling and Geolocation Services

- Applicable to propagation paths within geomagnetic latitudes of 20-60 degrees, because of lower complexity than polar or equatorial regions
- Ionospherically-informed TDOA-based geolocation
- Integrate with fully automated assimilative ionospheric models that ingest a variety of sources of varying quality and cadence
  - Short-range (<150km): Performers expected to include a short-range model. A reference short-range model will be provided by the government by month 3.
  - Long-range (>150km): The offeror will propose a long range model that conforms to an API negotiated with the government by month 3. This development must be a separately priced task. During the course of the program, the government *may* provide an alternate model that conforms to the same API. The offeror would then be able to choose the model or models that provide(s) the best overall solution.
- Service-oriented Application Programming Interface (API) for both models, approved by IARPA to ensure commonality between solutions

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Enabling Technology Addressed in Phase 1

Phase 1A

- **Innovative HF antennas**
  - Potential to shrink system size and improve sensitivity
- **Advanced signal processing techniques**
  - Signal selection enabling noise suppression and better geolocation accuracy

Phase 1B

- **Accurate ionospheric measurements integrating novel sources**

Phase 1 Teams

Phase 1A Performers

Advanced HF Signal Processing

- leidos
- STRAD CORPORATION
- NWRA Since 1984
- STR SYSTEMS & TECHNOLOGY RESEARCH
- IAA
- NORTHROP GRUMMAN

HF Sensor

- SoneSys
- MegaWave CORPORATION
- Roke (UK)

Phase 1B Performer

- NWRA Since 1984
- ASTRA

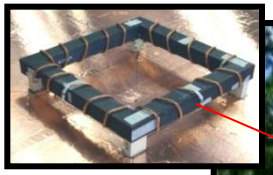
Innovative Antennas

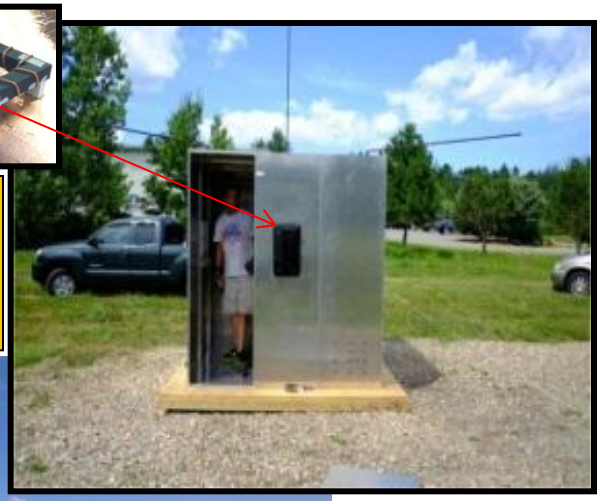
Phase 1A Goals:

- **Design vector sensor antennas that support precisely determining angles-of-arrival of impinging signals (azimuth and elevation)**
- **Support multiple signal separation**
  - By arrival angle
  - By polarization state
- **Small footprint**

Vector Sensing

- An Electromagnetic Vector Sensor (EMVS) enables a single element to estimate Angle of Arrival (AoA) and signal polarization state
- Full vector sensors include six axes



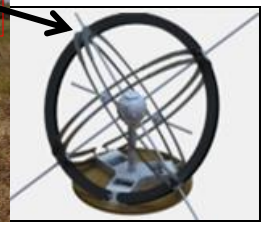


11-D vector sensor using picture frame loops (above) built for HFGeo Phase 1A

SPAWAR-SSC Pacific built Government Reference Antenna

DSTO "Giselle" 3-axis sensor

Array of NRL built 6-axis sensors as deployed at Vero Beach FL during Phase 1A



Sonesys/Megawave Phase 1A Vector Sensor Antenna

"11-D Fractional Wavelength Array"

Box size = 2m x 2m x 2m

5-Monopoles (1-TM & 4-TE) = 1.5m

1-TM Picture Frame (NS/EW) =0.36 x 0.36 x 0.1m

4-TE Picture Frames = 0.36 x 0.21 x 0.1m

Footprint = 3.78 x 3.78m (14.3m²)

Height = 3.5m

Max. Dimension: 5.34m (0.178 λ @ 10MHz)

2 People ≈ 3 Hours Setup

Shipping: 250kg (≈ 550 lbs)

Phase 1A Sensor Technical Metrics

Parameter	Phase 1	Program Objective	Current Assessment of Phase 1A Results
Angle-of-arrival accuracy	0.8 deg @ 30 dB SNR	0.1 deg @ 30 dB SNR	Met in simulation; check target performance within 1° of expected azimuth at low SNR, but ionospheric impacts unknown
Noise figure	<20 dB @ 8 MHz	<15 dB @ 20-30 MHz <20 dB @ 8-20 MHz <25 dB @ 3-8 MHz	23 dB by measurement and analysis
Operating Bandwidth	5-10 MHz	3-30 MHz	Demonstrated by performer
Gain	>-5 dBi	>0 dBi center band >-5 dBi 5-30 MHz >-10 dBi 3-5 MHz	Demonstrated by performer
Polarization sensing	Fully polarimetric	Fully polarimetric	Met by design
Polarization isolation	>20 dB	>30 dB	> 37 dB on scale model
Footprint	Single element or building block	< 40 m in any dimension < 15 m height	Meets requirements

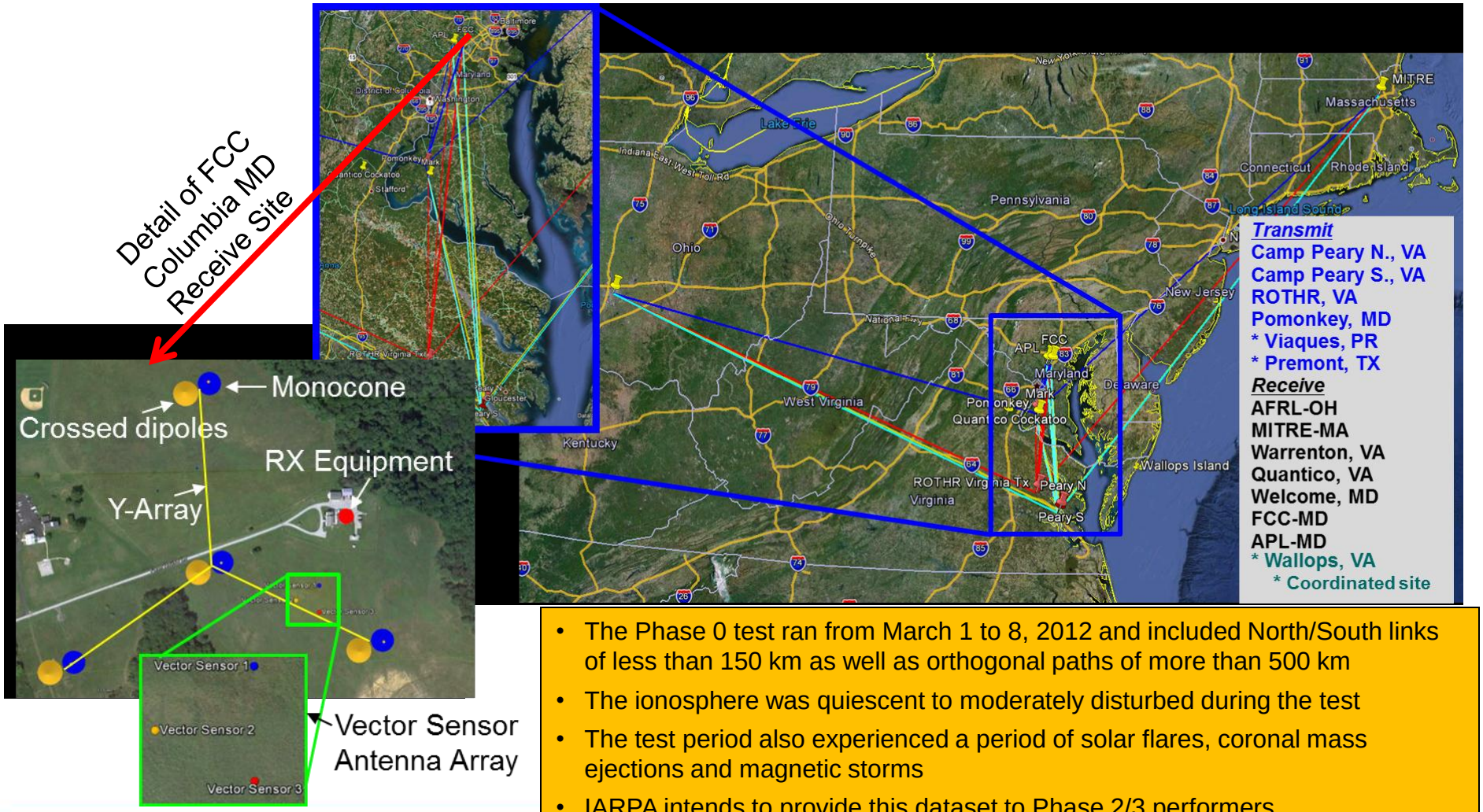
Government Reference Antenna

- Functionality
  - 3 orthogonal ground symmetric loops
  - Two ports on each loop provides a **loop** and a **dipole** mode
  - This provides 3 orthogonal loop and 3 orthogonal dipole modes
  - Designed to be externally noise limited above 4MHz
- Dimensions
  - Loop diameter is 1 meter flat-to-flat
  - Foundation height is 5 feet
- Status
  - Currently being tested
  - IARPA intends to provide key technical information to Phase 2/3 offerors

Phase 1A Advanced Signal Processing

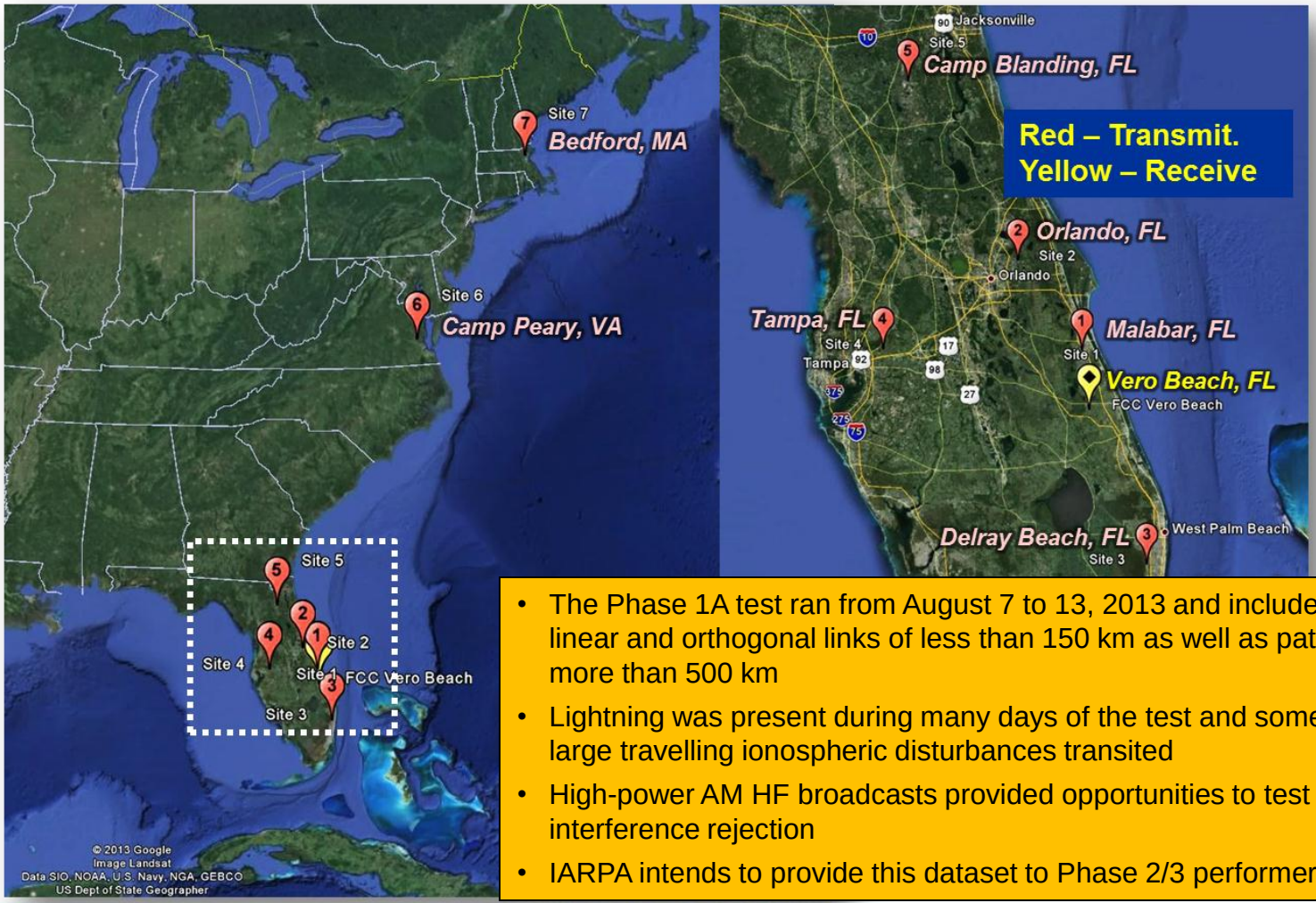
- **Goal is to enable smaller systems to detect more sources with better geolocation accuracy**
- **Exploit HF propagation physics in new ways**
  - Understanding of noise has evolved significantly
  - Potentially applicable signal processing approaches have been developed
- **Focus on:**
  - Advanced noise suppression techniques
  - Efficient use of small arrays
- **Performers were provided GFI measured data from the NRL vector sensor antenna**

Data Collection Prior to Phase 1



- The Phase 0 test ran from March 1 to 8, 2012 and included North/South links of less than 150 km as well as orthogonal paths of more than 500 km
- The ionosphere was quiescent to moderately disturbed during the test
- The test period also experienced a period of solar flares, coronal mass ejections and magnetic storms
- IARPA intends to provide this dataset to Phase 2/3 performers

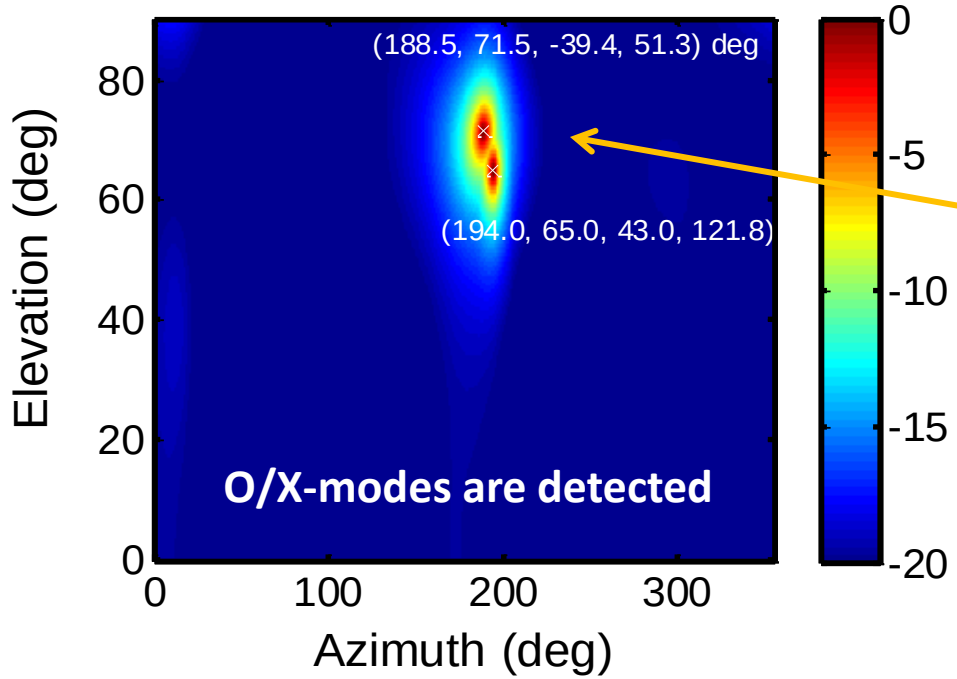
Phase 1A Field Test & Data Collection



- The Phase 1A test ran from August 7 to 13, 2013 and included co-linear and orthogonal links of less than 150 km as well as paths of more than 500 km
- Lightning was present during many days of the test and some very large travelling ionospheric disturbances transited
- High-power AM HF broadcasts provided opportunities to test interference rejection
- IARPA intends to provide this dataset to Phase 2/3 performers

Propagation Mode Separation

- Use of polarization improves isolation of modes from each individual emitter and thereby improves space and time resolution



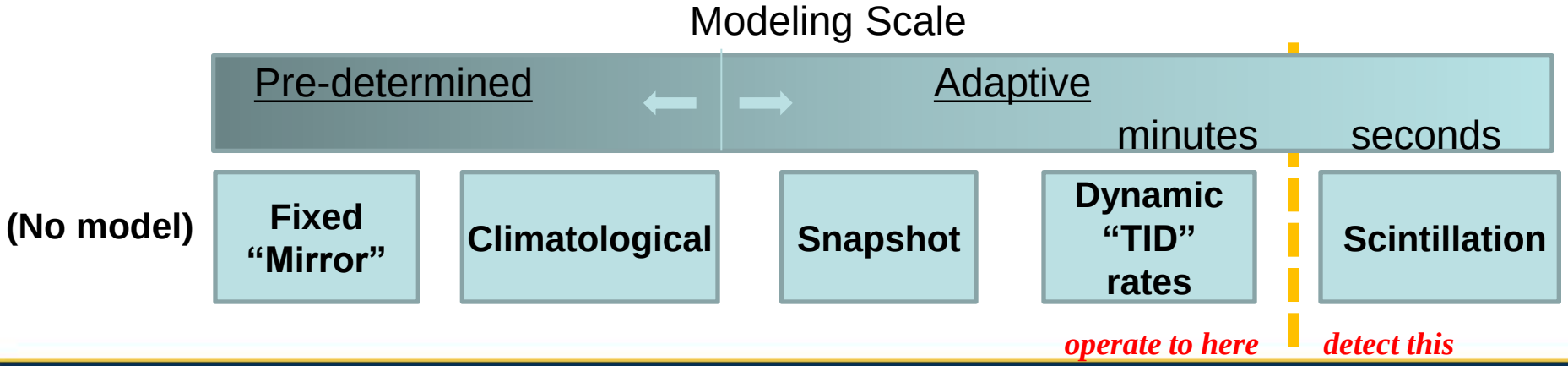
- Live data that shows ability to separate right (negative) and left (positive) circular polarization
- Without multi-polarization processing, the 2 propagation modes would not be detected and AoA accuracy would degrade

Vector Sensor and Array Calibration

- Super resolution techniques require accurate calibration
- On-site calibration may not be practical operationally
- Sensor/Array calibration is dependent upon environmental conditions
  - During the Phase 1A test, in-situ calibration changed over time as the ground plane changed from wet; to damp; to dry (varying dielectric)
- Phase 1A performer approaches to calibration
  - Implemented auto- or self-calibration techniques on the sensor array
  - Studied use of lightning sources as a calibration aid
  - Used skywave propagation to complement in-situ calibration sources
  - Suggested the use of a far-field (>1 km) source for in-situ calibration
  - Rejected data from array elements they believed to be faulty
  - Studied the directional nature of HF noise and used that data in their calibration processes

Phase 1B Ionospheric Measurement & Modeling

- **Ionospheric understanding is required**
  - For accurate geolocation
  - For HF skywave an ionospheric bottom-side profile is required
- **Several measurement sources could enhance performance**
- **What are the ionospheric measurement limits/requirements?**
  - Ionosphere changes minute-to-minute & over 3D of space
  - Prior published studies were for long-range oblique paths, and did not exploit polarized elements



Some Potential Sources of Ionospheric Data

Source	Data	Phase 1B
Global Navigation Satellite Service (GNSS)	Whole ionosphere Total Electron Content (TEC) & relative TEC	Collected and assimilated
Surface Wave Radar	AoA and Doppler shift providing information on bottom side irregularities	Not specifically collected
AoA from Known Sites	AoA and Doppler shifts providing information on bottom side irregularities	Collected
LEO Satellite Beacons	TEC & Relative TEC, but from a lower altitude than GNSS	Collected, but had high interference
Optical	Some plasma densities from dark skies	Collected, but not used

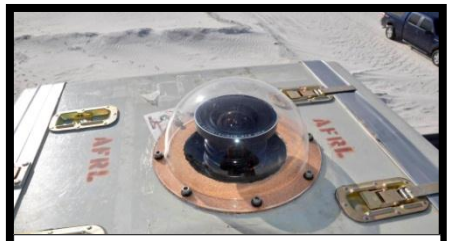
Phase 1B (January 2014) Data Collection

Provides >20 terabytes of data for detailed propagation understanding

IARPA intends to provide this dataset to Phase 2/3 performers

Central Tx Site Equipment

Check Target site with GPS receiver

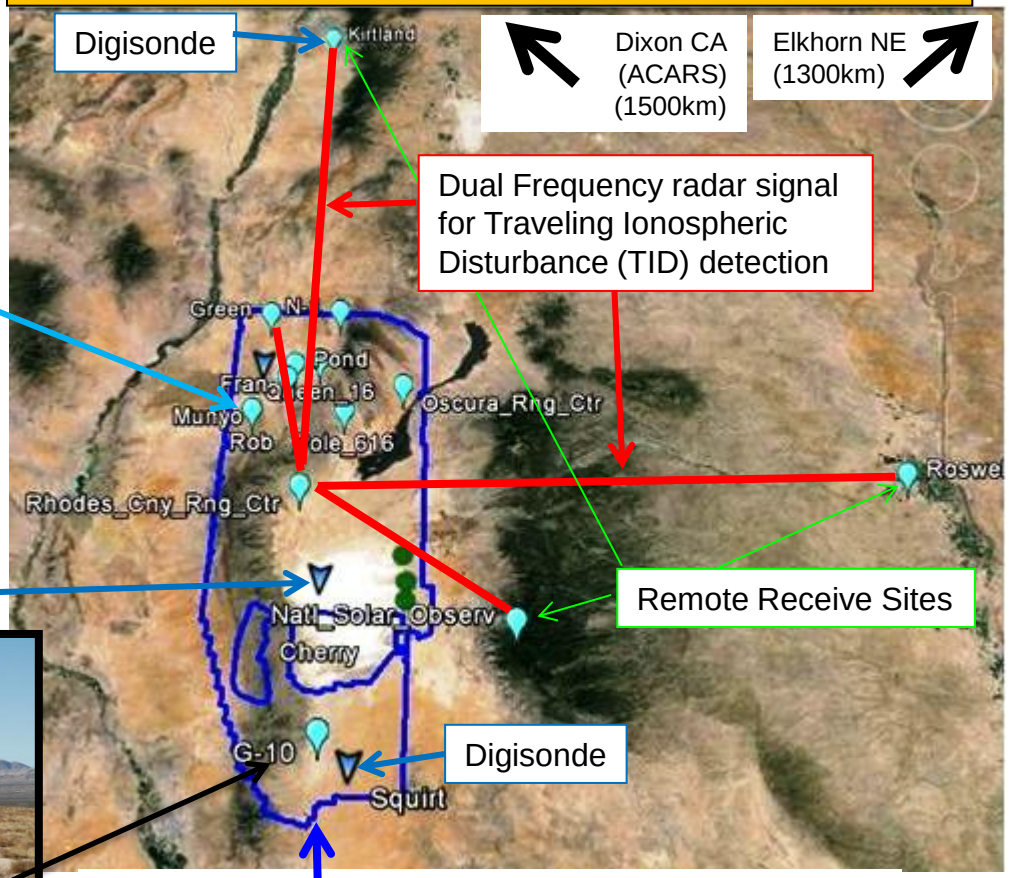


Optical Sensor at Midpoint

Midpoint Digisonde Site

Receive Site Equipment

Main array receive site: G-10



White Sands Missile Range, New Mexico

HFGeo Phase 2 and 3 Goals

- **Phase 2**
  - Develop an integrated system that provides a prototype of this capability
  - Fully automated solution
  - Operates with relaxed latency requirements
- **Phase 3**
  - Real-time processing in representative conditions
  - Fully automated solution

Outline

- Introduction
- Technical Challenge
- Results from Phase 1
- Metrics and Programmatics
- Administrative

Phase 2 and 3 Programmatics

- **Phase 2**
  - Key technical developments
    - Integrated subsystem of sensor with signal processing
    - Integrated subsystem with ionospheric model and geolocation
    - Completely integrated prototype
  - Includes Preliminary Design Review
- **Phase 3**
  - Performers will build real-time integrated system
  - Includes Critical Design Review
- **Both Phases**
  - Signal processing design should leverage Phase 1A developments
  - The Phase 1B ionospheric model will be provided as GFE, but the performer is not required to use it
  - The geolocation solution will conform to a defined service-oriented Application Programming Interface (API)
  - The phase 2/3 ionospheric model will conform to its own service-oriented API

Metrics and Constraints

- **Performer solutions will be evaluated using metrics on**
  - Geolocation accuracy
  - Geolocation reliability
- **Solutions must meet constraints**
  - Instantaneous operation over 3-20 MHz
  - Size, weight, and power
  - Geolocation latency and throughput

Use Case Overview

- Use cases will be identified to describe the different scenarios in which the Phase 2/3 solution could be applied
- Use cases will include:
  - Single site location (SSL) using HFGeo sensor
  - HFGeo sensor with one or more remote sites providing azimuth AoA
  - HFGeo sensor with one or more remote sites providing azimuth or azimuth/elevation AoA and received signal snapshots
- Use cases will be described in classified session

Primary Geolocation Measures

- **Performers will be required to provide 3D location estimates for emitters once per second**
  - Requirements will be placed on Probability of Detection (PD) and Probability of False Alarm (PFA)
- **Geolocation accuracy will be computed as the semi-major axis of the 2D 90% error containment ellipse**

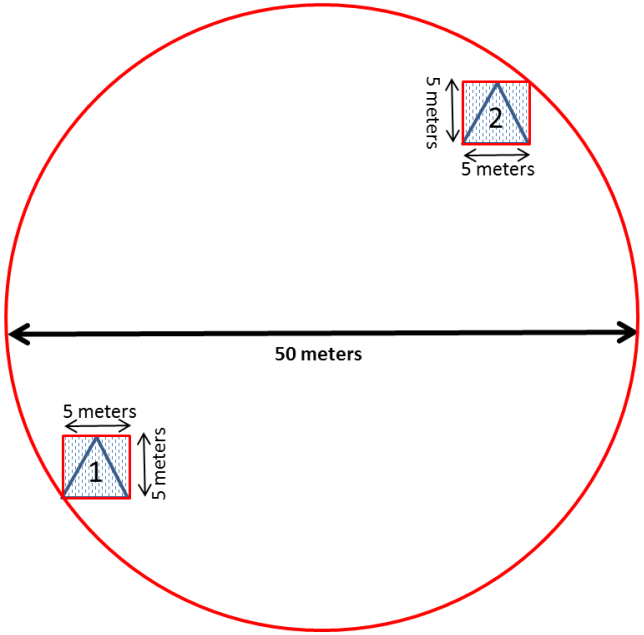
Size, Weight, and Power Constraints

- The sensor node must satisfy size, weight, and power constraints to ensure greatest flexibility in deployment
- Antenna (constraints apply to Phase 2 and 3)
  - Size: Contained in circle <50m diameter
  - Wind resistance: sustain winds up to 30 kts
  - Height: will not exceed 10m
  - Weight: total weight will not exceed 150kg, including any support structures and cabling
  - If used, local calibration sources used for system performance may be located outside the area limits, but they are included in the total weight and will not exceed 10m height
- System electronics (constraints apply only to Phase 3)
  - Total volume: will not exceed $2m^3$, including heating and cooling
  - Temperature: must operate from -5C to 45C
  - Power: will not exceed 15kVA (including calibration sources, if used)
  - Power supply: not included in volume

Phase 2/3 Antenna Size Constraints

Illustrative example to clarify constraint

- All heights <10m
- The total physical extent enclosed by the antenna must fit with a circle of diameter <50m



For example, consider 2 vector sensor antennas, each of which can be secured on the ground in a 5m x 5m square. If they are placed in the arrangement shown here, the smallest circle that encloses the footprints is 50m. The actual spacing between phase centers is less.

Geolocation Latency and Throughput

Geolocation Latency and Throughput		
	Latency	**Throughput**
Phase 2	Geolocation estimate for 4 hours of receive data provided within 24 hours of reception of ionospheric information and remote site data	N/A for Phase 2
Phase 3	Precise geolocation estimate within **15 minutes** after reception of ionospheric model information and remote site received data Coarse geolocation estimate within **1 minute** of signal reception and remote site received data (meets relaxes accuracy requirements)	Provide **100 solutions or more per minute** (precise and coarse).

Programmatic Milestones

Months after Contract Award	Milestone Description	Metric	Other information
Month 0	Phase 2 start		
Month 9	Live data recording	Physical constraints	Live data collect Government provides emitters to locate & ground truth
Month 11	Geolocation of emitters from Month 9 collection	Meet 2X Phase 2 geolocation accuracy metrics	
Month 16	Phase 2 evaluation	Meet all Phase 2 metrics	Live data collect Government provides emitters to locate
Month 24	Phase 3 demonstration and self-evaluation	Meet 2X Phase 3 throughput metric, all physical constraints, and 1.5X all Phase 3 geolocation metrics	Use data recorded during month 9 collection
Month 31	Phase 3 real-time evaulation	Meets all Phase 3 metrics	Evaluation of prototype system under realistic conditions Government provides emitters to locate

Phase 1 Algorithms

- **We expect to make descriptions of the following available after BAA release**
  - More detailed description of Sonesys/Megawave Phase 1A antenna system
  - More detailed description of key Phase 1A signal processing algorithms
  - More detailed description of SPAWAR antenna and measurement data
  - More detailed description of the Phase 1B ionospheric model
- **We expect to make the following information available upon start of Phase 2**
  - MATLAB implementations of key Phase 1A algorithms
  - The Phase 1B ionospheric model
- **This information should help the offeror better understand the effort conducted in Phase 1**
- **If an offeror believes new equipment, models, or algorithms will better meet the program goals, the proposal should explain why they will outperform the Phase 1 approaches**
- **Offerors may propose an alternate long-range model as a separately priced option**

Intellectual Property Rights

- **Government requirements include the need to share the developed technology, as well as the need to transition the deliverables to other Government entities and contractors that support these Government entities for governmental purposes.**

- **Therefore, if limited rights are asserted by the proposer, the proposal must identify the potential cost associated with the Government attaining government purpose data rights.**

Outline

- Introduction
- Technical Challenge
- Results from Phase 1
- Metrics and Programmatics
- Administrative
  - Security and ITAR
  - Proposal Guidance and Evaluation Criteria

Security, Publication, and ITAR

- **Solicitation will be an unclassified BAA with a classified appendix**
  - Classified appendix describes detailed use cases and values of the performance metrics
  - There can be significant unclassified work that support this effort in terms of ionosphere-informed propagation and signal processing. So the general program goals and architectures will be described at unclassified level
- **Performers must get approval from IARPA C/Security to write/process proposals**
- **Highest performer classification will be collateral Secret, releasable to US, Australia, United Kingdom, Canada, and New Zealand**
  - Prime must have existing Secret facility with storage authorization
- **BAA main body will be posted on FedBizOpps**
  - Will include instructions to contact IARPA security to obtain the classified appendix
- **IARPA security will vet facility and personnel clearances and work with HFGeo program office to provide the classified annex to performers**
- **Publication is encouraged, but due to the sensitive nature of this work, IARPA will require pre-publication approval**
- **The State Department, not IARPA makes ITAR determinations**
  - Performers need to be responsible

Eligibility Information

- **Other Government Agencies, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), and any other similar type of organization that has a special relationship with the Government, that gives them access to privileged and/or proprietary information or access to Government equipment or real property, are not eligible to submit proposals under this BAA or participate as team members under proposals submitted by eligible entities**
- **Non-US organizations and individuals may be able to participate**
  - Must comply with Non-Disclosure Agreements, Security Regulations, Export Control Laws, etc. as appropriate
  - Specific guidance for non-US participation will be provided in the BAA

Proposal Guidance

- **Your proposal should include a full discussion of the technical approach that will be used to meet the program goals.**

- **Programmatic issues to be addressed in the proposal:**
  - Your team's current technical capabilities.
  - Key resources needed (not currently available to your team), to include capital equipment and special expertise. The risk in acquiring these key resources, and mitigation strategies, should be indicated as well.
  - A teaming plan along with the roles and responsibilities of each member of the research team.
  - End of phase and some intermediate milestones are set, but it is expected that other intermediate milestones that are on the critical path of the proposed approach will be offered.
  - A schedule of all milestones including a clearly charted description of the various risk mitigation strategies that will be undertaken to achieve program goals.
  - Overall plan/approach for corporately complying with, implementing, and maintaining security related policies, procedures, and directives.

Proposal Evaluation Criteria

- **Overall Scientific and Technical Merit**
- **Effectiveness of Proposed Work Plan**
- **Relevance to IARPA Mission and HFGeo Program Goals**
- **Relevant Experience and Expertise**
- **Cost Realism**
- **Effectiveness of Proposed Security Plan**

Evaluation criteria will appear in the BAA.

Additional Information

- **Email dni-iarpa-baa-14-05@iarpa.gov with additional unclassified questions**
- **HFGeo BAA will be posted on FedBizOpps website (www.fedbizopps.gov) and then noted on www.iarpa.gov**
- **Unclassified Q&As will appear after the BAA is posted. Classified Q&As will be provided to those with confirmed secure facilities and security clearances.**