The NPS Maritime Domain Protection Research Group

Coalition Operating Area Surveillance and Targeting System (COASTS)

Mr. James Ehlert
13 December 2005

Higher Echelon Guidance...

- From the draft ASD(HD) Maritime Domain Awareness Initiative Guidance:
  - NPS "is tasked with developing and executing several research programs, including data and target modeling, war gaming, threat and vulnerability assessments, and data integration."
  - "All projects must support overarching national policy as well as the DoD *Strategy for Homeland Defense and Civil Support* and the *National Strategy for Maritime Security*."

NPS Expertise & Resources

- Systems Engineering
- Computer Science
- Information Science
- Operations Research
- Defense Analysis
- Modeling and Simulation
- Meteorology and Oceanography
- Physics
- Intelligence
- Information networking

- US Navy/Marines
- US Coast Guard
- US Army
- US Air Force
- Special Operations (All services)
- Civilian (Federal, State and Local)
- Coalition: ~300 students from 55 nations

• MDP spans the entire NPS campus and leverages both faculty & student expertise

Broad Charter Requires a Spectrum of Research Efforts

Define, design, and potentially implement a national Maritime Domain Protection System that includes a vulnerability assessment, concept of operations across multiple lines of defense and domains, and coordinated through a national command and control system.

FOCUS: War-fighters perspective to dissuade, deter, preempt, interdict, or defeat threats and aggression as early and as far from US borders as possible.

Current MDP Research…

- Decision making tools for comprehensive and agile MDP
- *Coalition Operating Area Surveillance and Targeting System (COASTS)*
- Development of a prototype knowledge management system for maritime domain data sources
- Knowledge discovery and data mining in large databases
- Multi-source fusion and correlation
- Integration tool for atmosphere effects on radar/IR Surveillance
- Ship detection and tracking with satellite observations in cloudy conditions
- MDP systems engineering design and Integration

COASTS Objectives

Primary: Rapidly deploy and integrate low cost, ***unclassified,*** networked air, ground, and maritime sensors providing real-time ***sensor-to-decision-maker*** information

Secondary: Foster information sharing at the R&D level and establish relationships with counter-parts to:

- exercise, train, and demonstrate with technology to counter illegal narcotics and immigration
- demonstrate and promote operational potential of inter-linked Command & Control / Data Fusion Centers
- utilize Red Teams (Joint IO Command) to address/ examine security implications at the on-set relative to the technologies of interest

Why COASTS?

- Secure borders contributes to regional & international stability and security

- Regional, UN and international focus on countering piracy, terrorism, illegal fishing, resource theft, smuggling and various other lawless activities that contribute to national, regional, and international instability

- *COASTS cooperation and research underway <u>today</u> while larger efforts (policy, ACTD, etc.) take shape*

The COASTS Imperative

- **9/11 Commission Report**
  - "Practically every aspect of US counterterrorism strategy relies on international cooperation."
  - "Coordinate the resolution of the legal, policy, and technical issues across agencies to create a 'trusted information network'."

- **National Security Presidential Directive NSPD-41; Homeland Security Presidential Directive HSPD-13, December 21, 2004: Maritime Security Policy**
  - ". . . Identify threats to the Maritime Domain as early and as distant from our shores as possible"
  - "Ensuring the security of the Maritime Domain must be a global effort, in which USG efforts are developed and furthered with the support of other governments . . . "

- **The National Defense Strategy of the United States of America, March 2005**
  - "The United States cannot achieve its defense objectives alone. Our concept of active, layered defense includes international partners."

Major Stakeholders

US Sponsors/Participants/Stakeholders

- U.S. Pacific Command (USPACOM)
- U.S. Coast Guard Monterey
- U.S. Embassy Bangkok
- Dept. of Homeland Security Immigration & Customs Enforcement (Bangkok)
- U.S. Special Operations Command (USSOCOM)
- Joint Inter Agency Task Force-West (JIATF-West)
- U.S. Marine Corps Systems Command
- Air Force Research Lab
- Lawrence Livermore National Labs

International Sponsors/Participants

- Thai National Security Council
- Defense Research & Development Office
- Royal Thai Air Force Combat R&D Office
- Royal Thai Air Force Academy
- Royal Thai Navy
- Interagency Intelligence Fusion Center, Chiang Mai
- Malaysian Maritime Enforcement Agency
- Australian Defence Tech & Management Advisor (Thailand)

Commercial Sponsors

- Mercury Data Systems
- CyberDefense UAV
- Identix
- Advanced Info Service (Thai)
- Roto-Motion

COASTS Vision

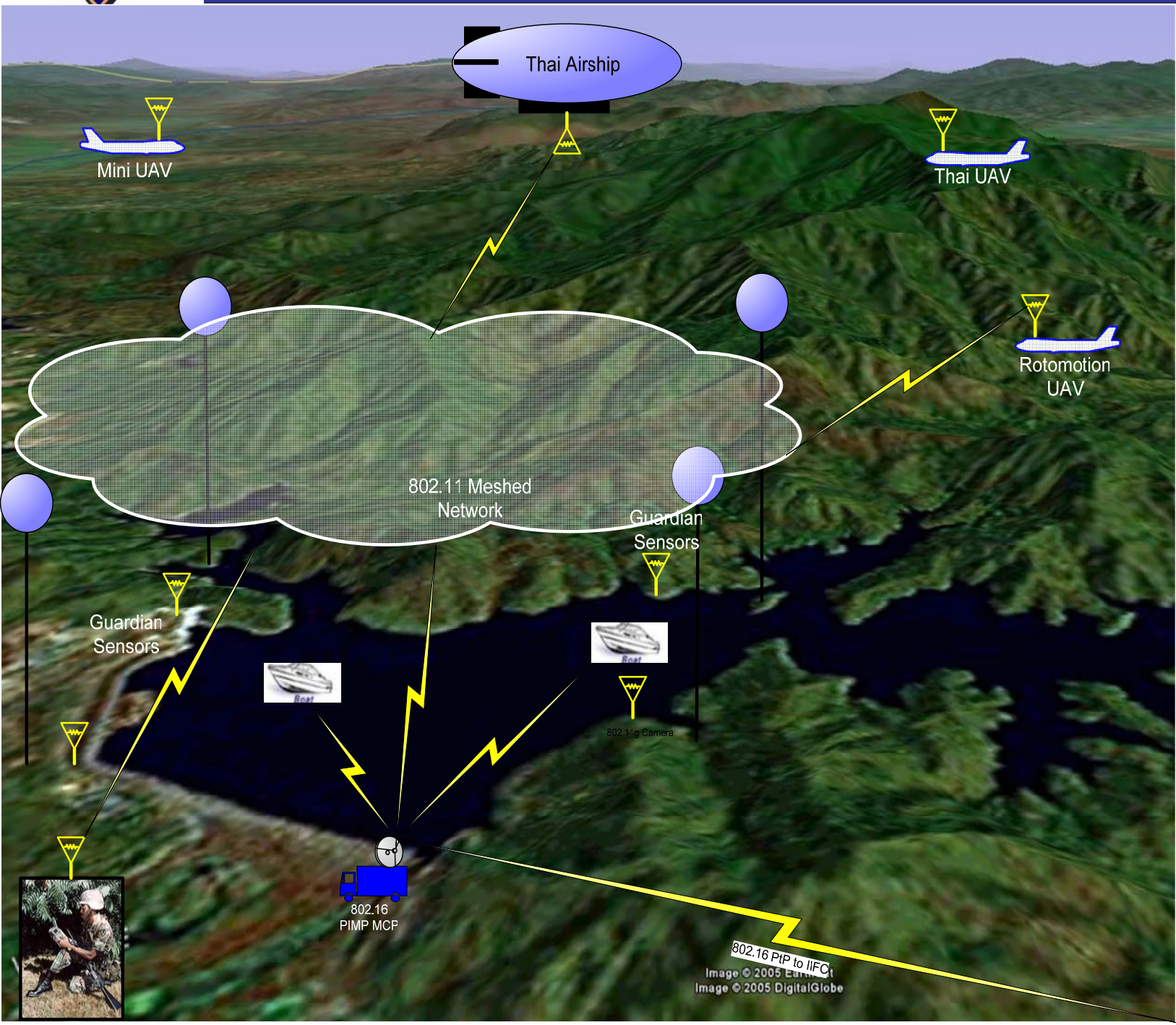
Vision:
Provide improved tracking of littoral and ground movements; ID which tracks are potential threats -- prioritize them for action and provide engagement confirmation and battle damage assessment.

COASTS Objectives:
1. *Test & Evaluate* the value of information exchange to improve Joint Ops Area (JOA) Awareness
    - Acquire, integrate, exchange relevant JOA activity information
    - Identify and track emerging threats using available information
    - Focus limited interdiction / interdiction assets on most probable targets

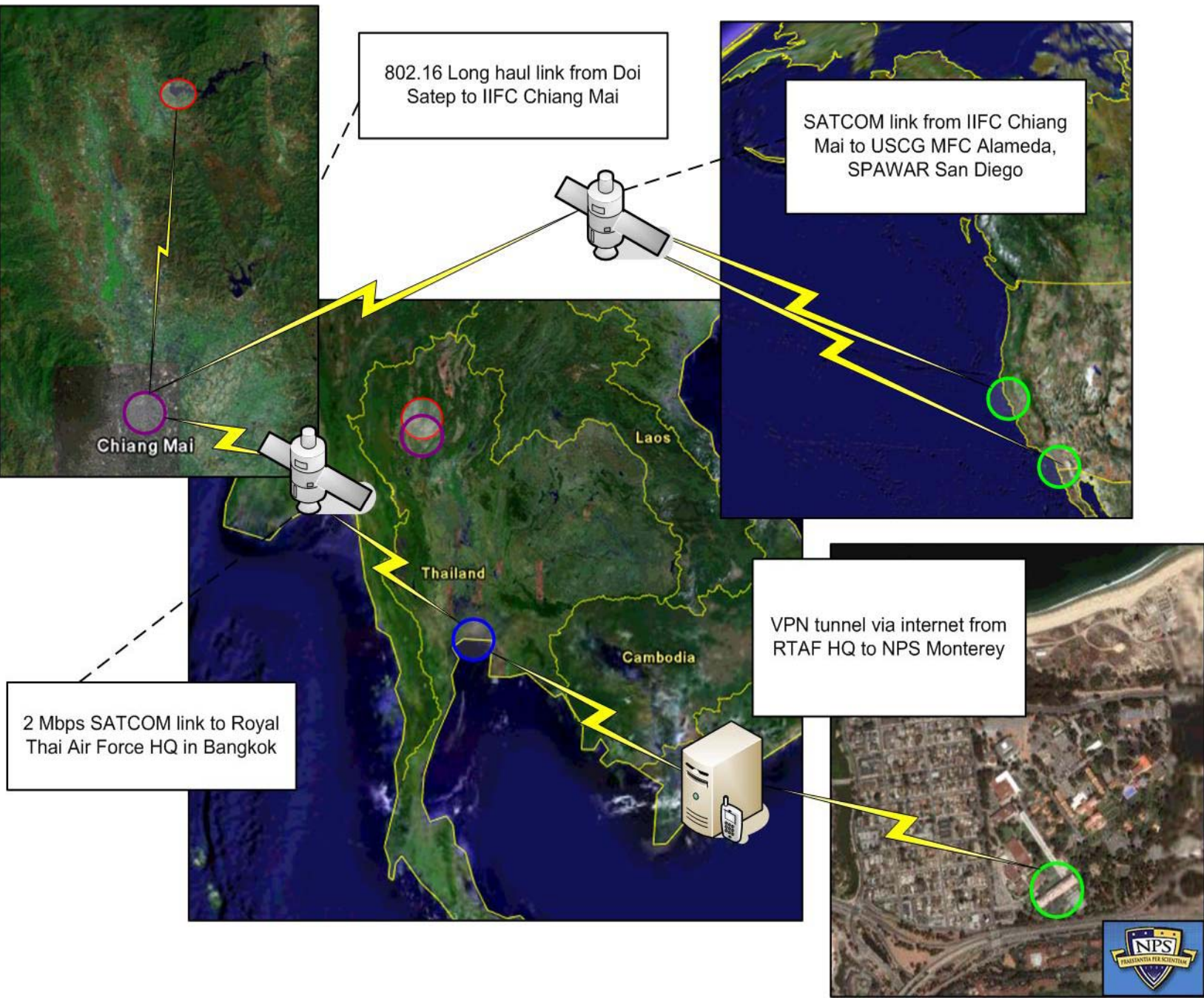
2. Test & Evaluate the flexibility, mobility, durability, and scalability of a COTS 802.11 a/b/g and 802.16 wireless network deployed in rugged and varied terrain under adverse climatic conditions.

3. Test & Evaluate net-centric information management for improved JOA Awareness, applicable across tactical, operational, and strategic domains
    - Data is visible, available, and usable when and where needed

Scenario Topology



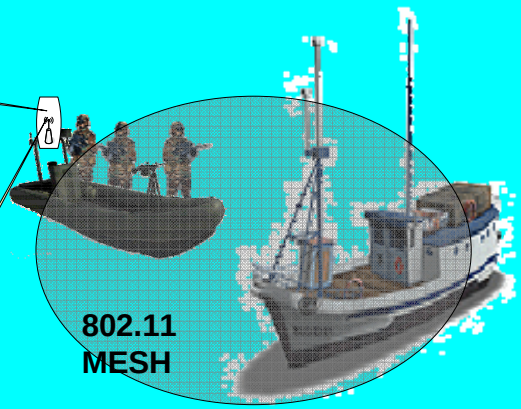
Global Topology



Scenario Over View

RHIB equipped with the maritime FLAK. FLAK will include a omni-directional antenna, AN-50 bridge, PATROLCAM, laptop, UPS, wearable IP camera and an 802.11g ITT/MESH dynamic link.

802.16

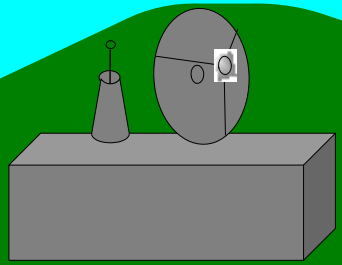


802.11 MESH

Patrol Craft equipped with the maritime Fly-Away Kit (FLAK). FLAK will include a omni-directional antenna, AN-50 bridge, laptop, and UPS.

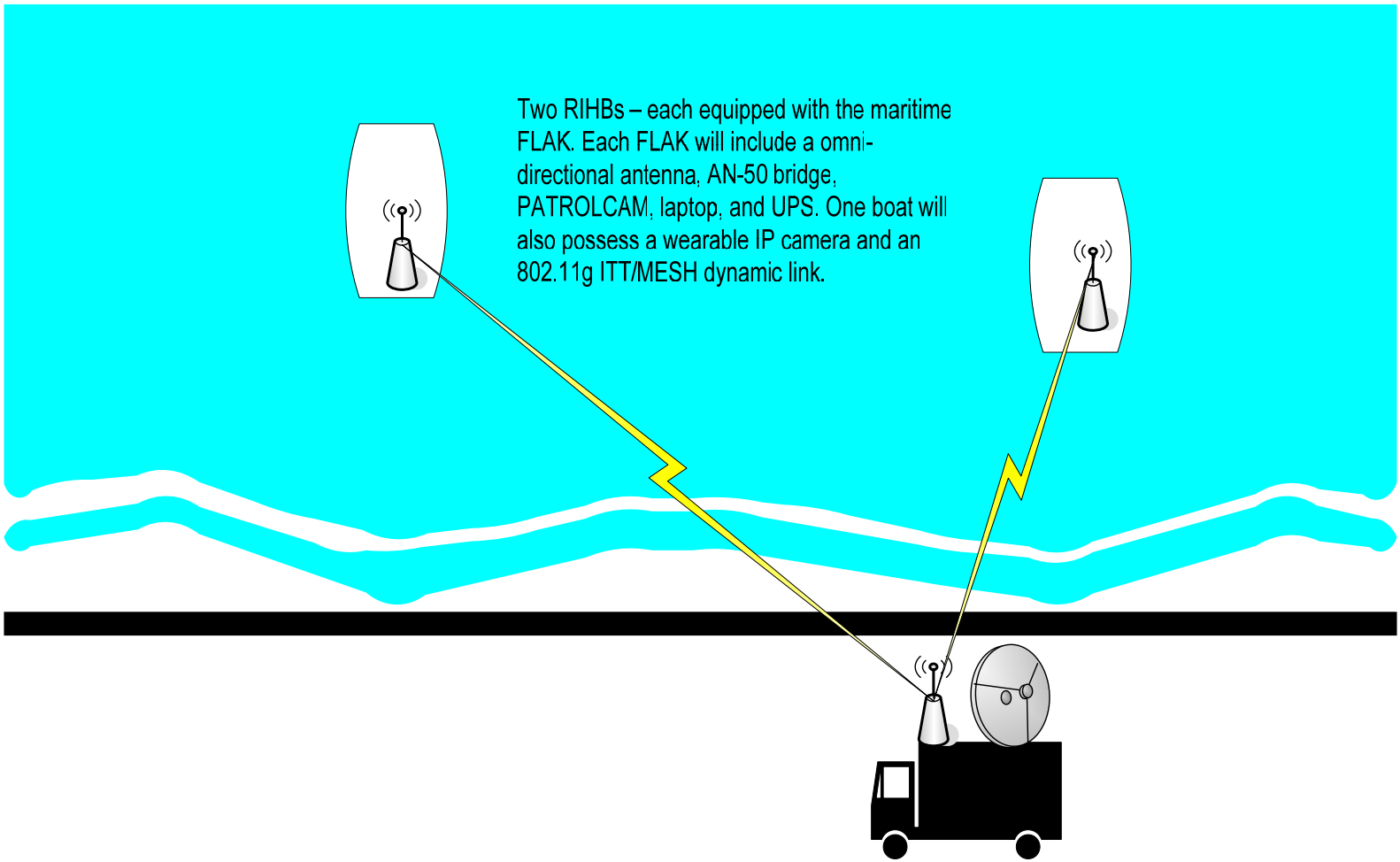
802.16

802.16



Control (C2) Center/HQ – Equipped with an 802.16 OFDM omni-directional antenna. Shore based Fusion Center or Command and Center can be linked back to HHQ via SATCOM or further 802.16 OFDM point-to-point links.

Maritime Topology



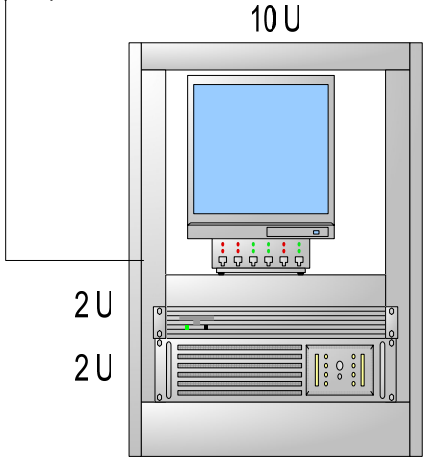
Mobile Command Post (MCP) – Command & Control (C2) Humvee with an 802.16 OFDM omni-directional antenna. This MCP will be linked back to the Theatre Operational Commander via SAT-COM or further 802.16 OFDM point to point links.

Littoral Communications

Using 802.16 OFDM wireless technology as a backbone, fly-away kits (FLAK) for C4ISR can be utilized to counter asymmetric threats in the maritime tactical theatre

Digital Mounted PATROLCAM

Pelican Cube Case



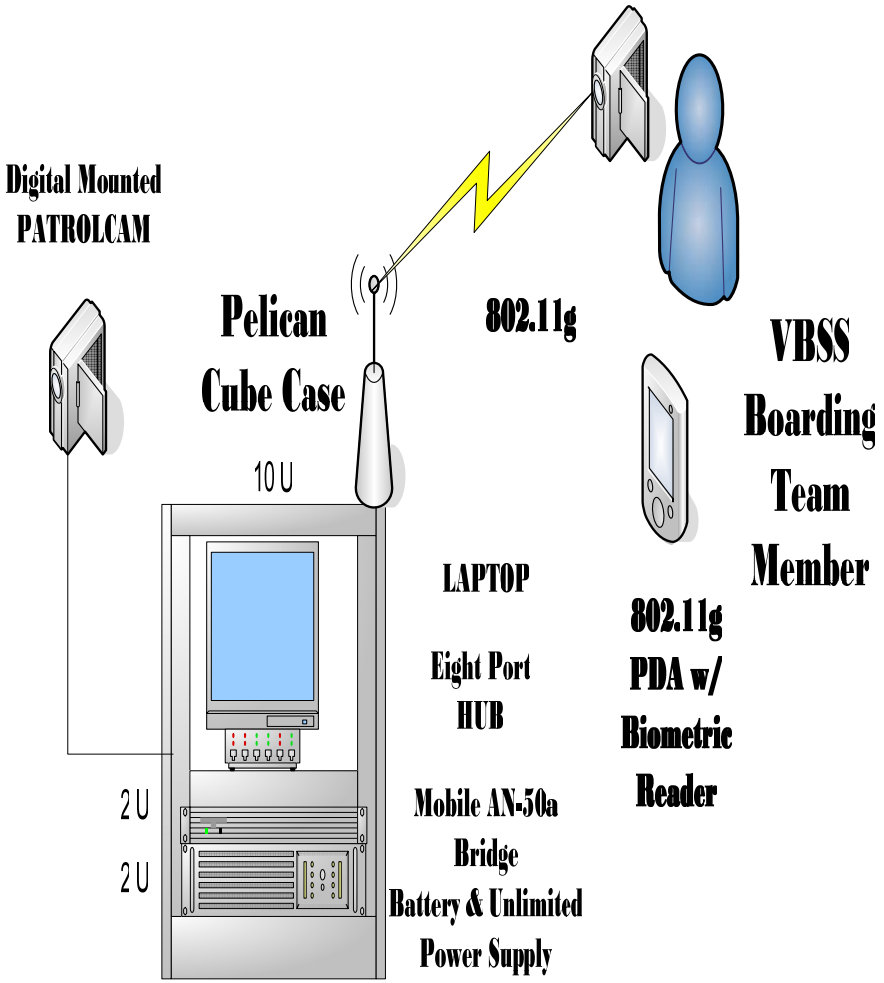
LAPTOP

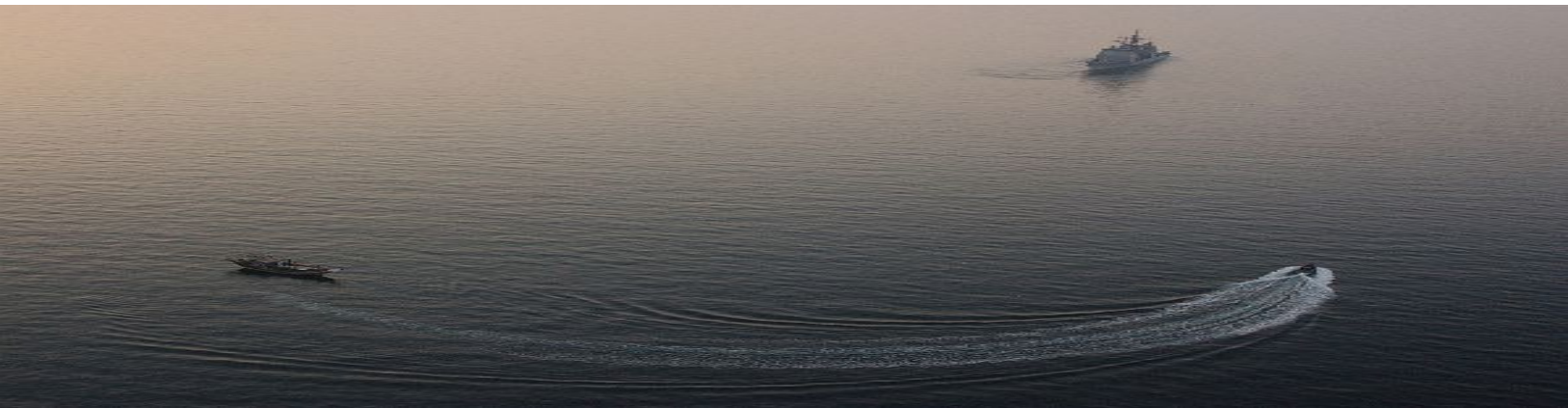
Eight Port HUB

Mobile AN-50a Bridge Battery & Unlimited Power Supply

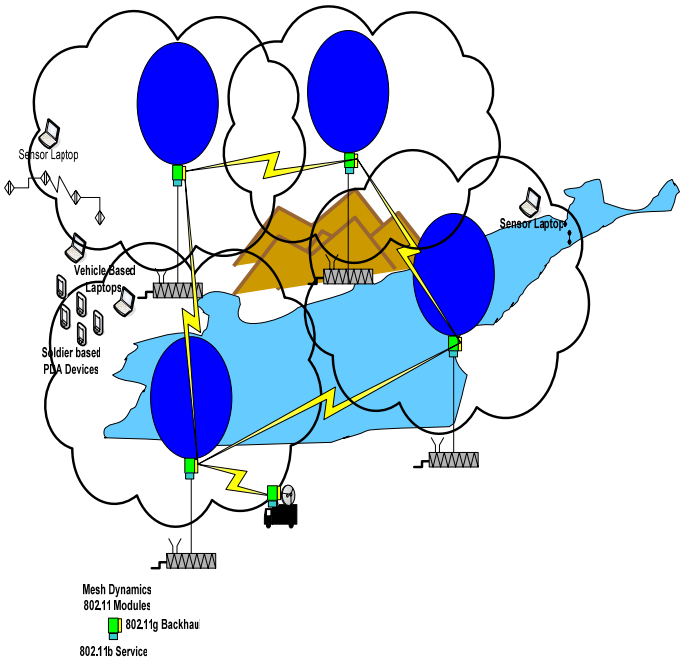
Maritime Communications

- The FLAK can be converted into a boarding intelligence / biometric data collection tool thru:
  - wireless access point
  - wearable wireless data camera
  - wireless biometric reader





802.11 B/G Meshed Network



"Provide Wi-Fi Connectivity for mobile Ground and Aerial clients."

MeshDynamics MD-325

- 2.4GHz Structured MeshTM backhaul
- Self-Healing, Self-Forming
- Session-persistent roaming
- Integrated 802.11 b/g access
- AES-CCMP encrypted backhaul
- WPA (Personal and Enterprise) security
- Multiple-SSIDs with 802.1q VLAN support
- Independent Security profile per SSID
- Remote Management and Monitoring
- Power over Ethernet
- NEMA rated outdoor enclosure

Aerial Balloon Node

“Demonstrate Extended range capabilities of 802.11 Meshed Networks by increasing the altitude of Network Nodes”

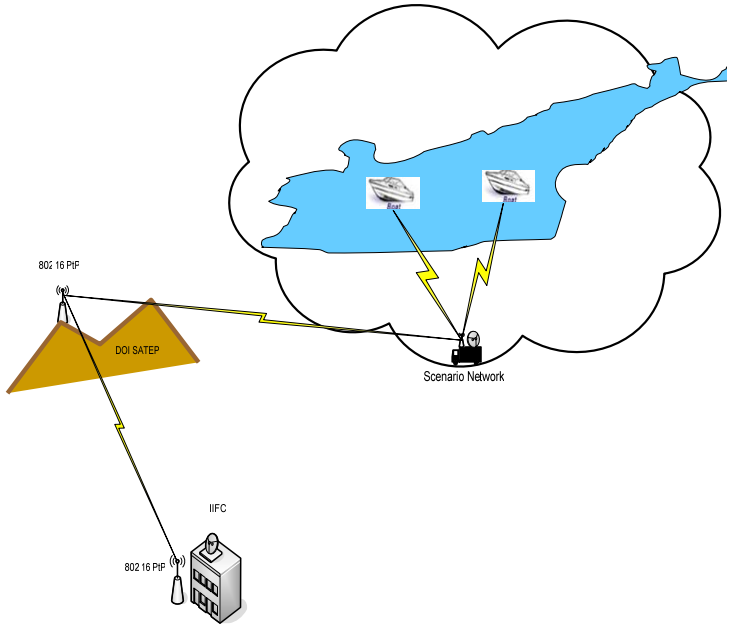
Blimp Works 3M Balloon: aerial platform with a MeshDynamics MD325 wireless node and Axis camera payload.

MeshDynamics MD325: provides ground and aerial 802.11b network coverage, and a wired connection to the Axis 213 camera (below).

Axis Communications Axis-213 IP Camera: a full Pan-Tilt-Zoom and auto-focus camera providing streaming video and still images over the network; capable of multicasting to multiple users.

802.16 Network Nodes

- Man portable 802.16 products provide:
  - High-throughput
  - Long-haul
  - Point to mobile-multipoint communications
- Connection to Mobile Maritime Units



Unmanned Aerial Vehicles

RotoMotion VTOL UAV

- 121cc 8.7 HP gasoline 2-stroke engine
- Up to 20kg /50 lbs payload capacity
- Ready-to-Fly
- Safety/Manual aircraft controller & transmitter
- 802.11-based telemetry system
- Stable hover (patent pending)

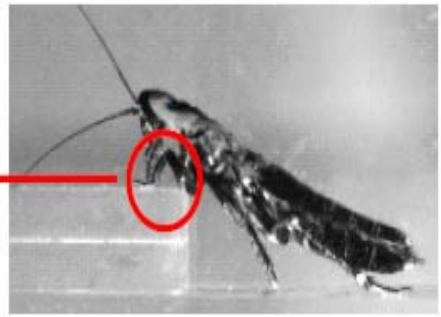
CyberDefense CYBERBUG

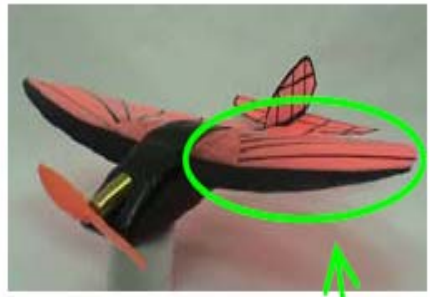
- Payload: Day/Night Camera
- Range:Control - 14 Miles, Video-2-3M
- Hand Launched
- Control
- Autonomous (GPS)
- Manual

Allsopp Helikite:

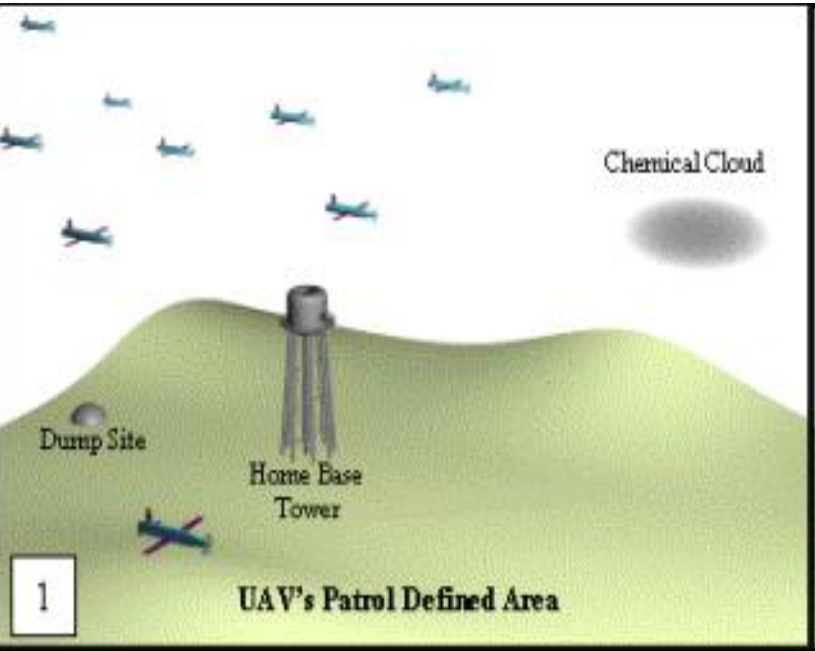
Compact, high altitude video surveillance

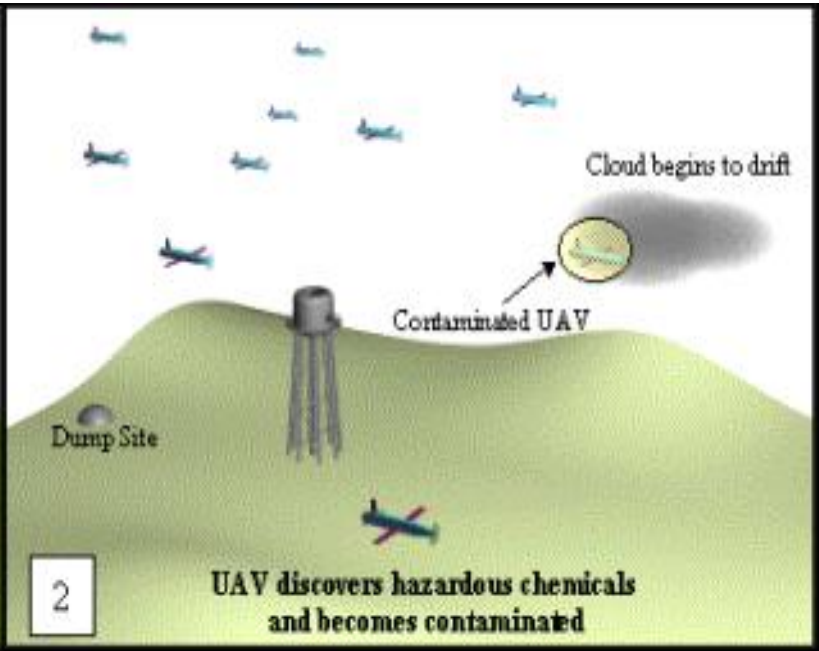
Micro Mobile Land Air Vehicle (MMALV) Prototype

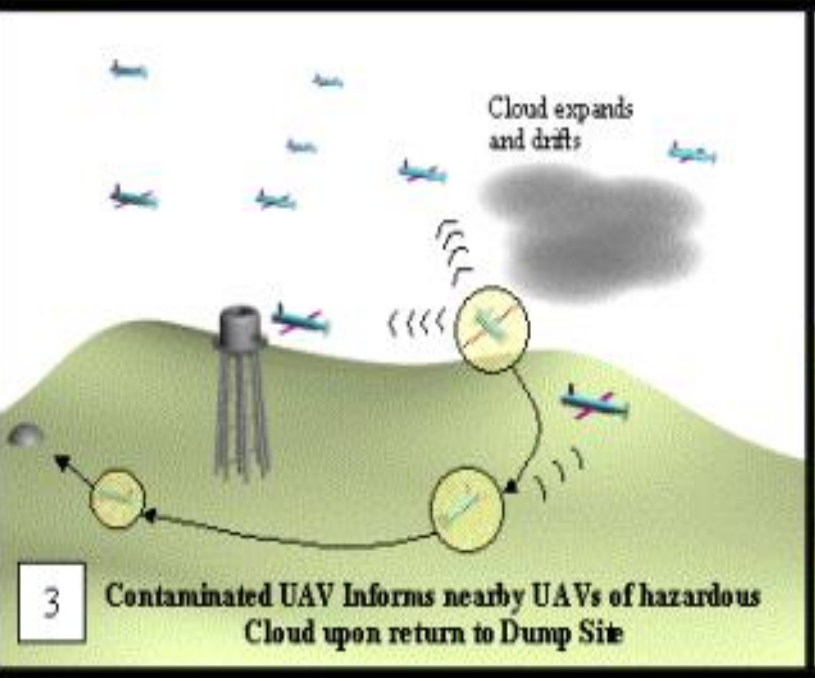


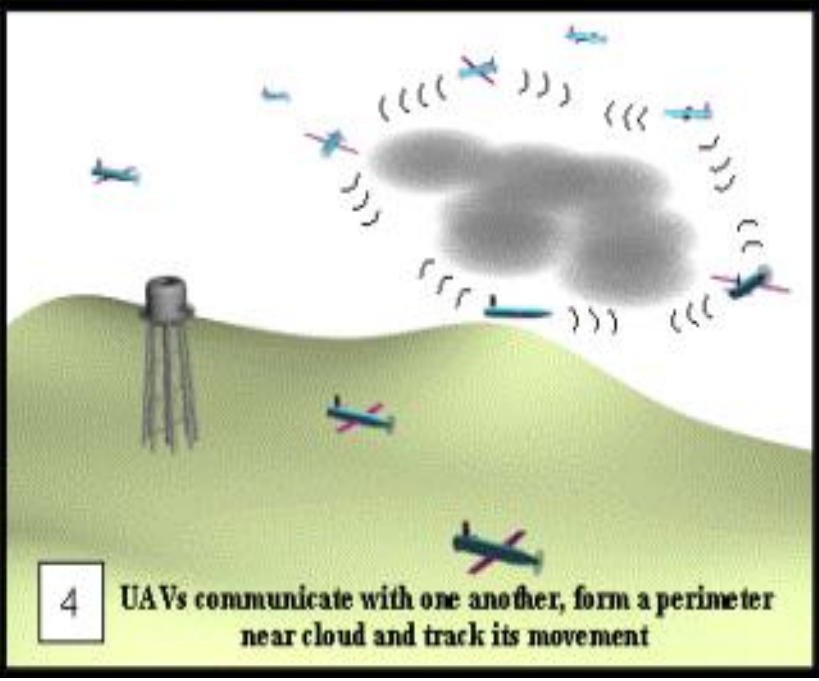


UAV Swarm Locating and Tracking Destructive Agents

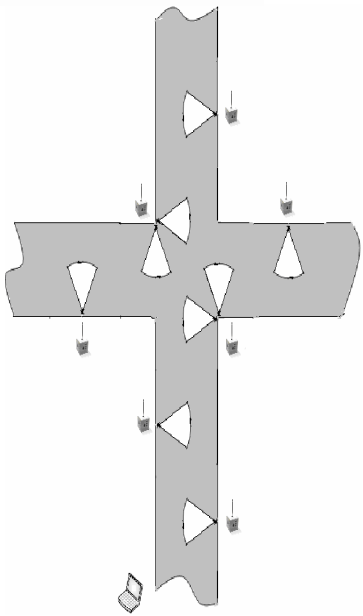






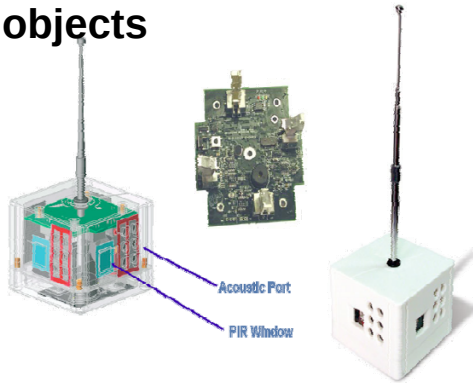


Crossbow Sensor Network



Asset Detection, Classification and Tracking

- **Passive IR detects and tracks targets up to 50 feet from sensor and up to 40mph**
- **Magnetometer used to classify objects**

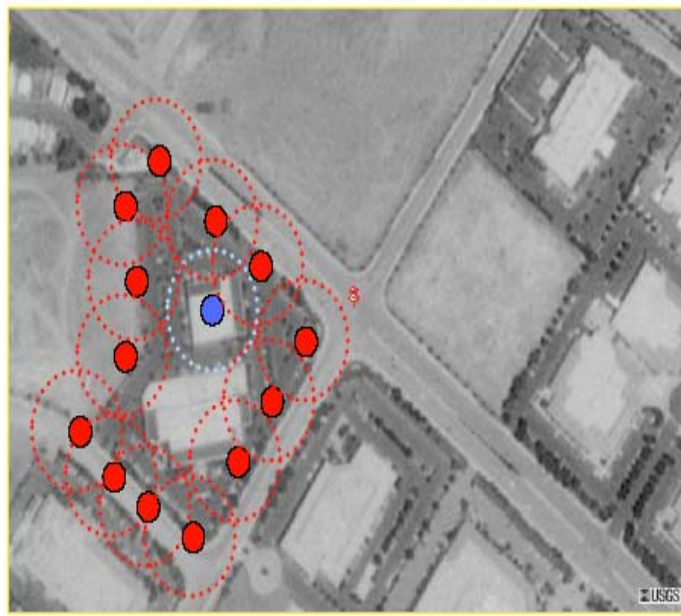


Perimeter and Border Security

- **Small & concealable**
- **Rapidly deployable, local or remote monitoring**
- **Dense node deployment increases effectiveness by providing overlapping detection areas**
- **System alarms provide early warning**
- **GPS capable**

Description

- **IEEE 802.15.4 Low data rate, Sensor network protocol**
- **Self-forming and Self-healing Mesh network**
- **Passive IR, Acoustic, and Magnetic Sensors**
- **Low power consumption**
- **Sensors powered by two AA batteries**
- **Covert Radar signal**
- **All weather day/night operation**



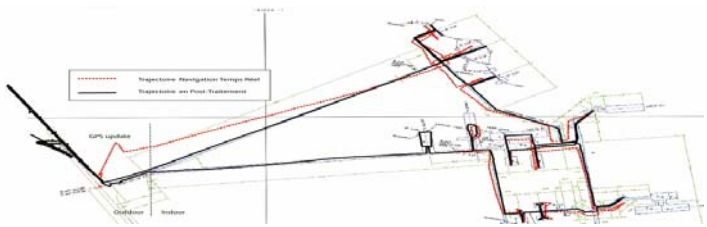
Blue Force Tracker: Deny GPS

Indoor, Outdoor, Jungle
or
Underground
Navigation and Location
Tracking for Personnel and
Unmanned Vehicle Systems

Lightweight
Wearable & Modular

Navigation when GPS Fails –
Inertial Navigation System (INS)

- Location and Tracking of any Assets
- Spatial Awareness Application
  - TrakPoint C2 - Command & Control
  - TrakPoint Mobile
- Perimeter Detection Sensors
- UAV Support
- Wireless Mesh Networks Communication
- Heads Up Display (HUD)



MERCURY Data Systems

vectronix

A3 IT Solutions

Biometric Identification

IBIS Mobile Identification System

- Fingerprints (Thumb)
- Photographic (Facial Recognition)
- 802.11B Compatible

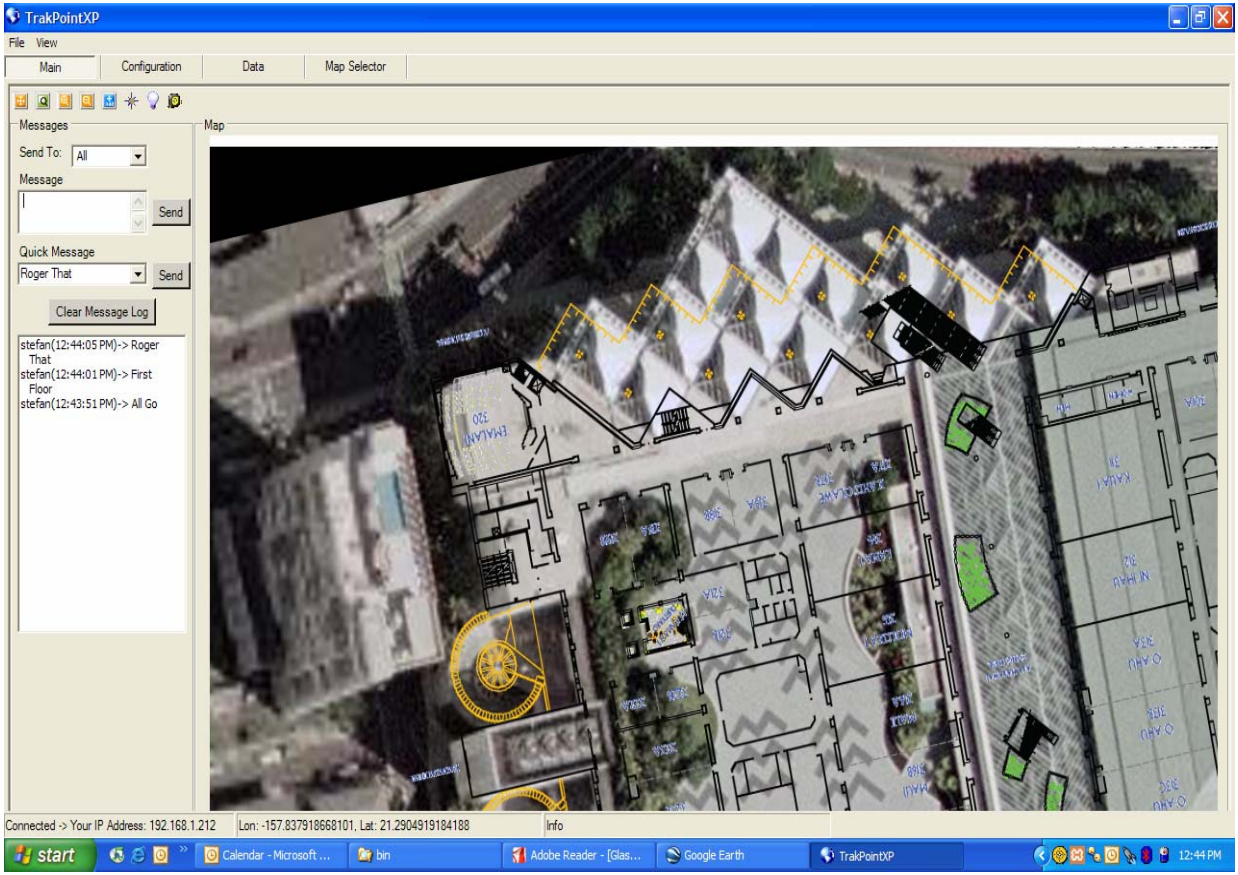
• Able to fingerprint and photograph suspects in the field and forward to a centralized database for future use

• Fingerprints and photos taken in the field of persons of unknown identification can be sent to IBIS server for comparison matching with prints and photos on file.

Biometric Explosive Detection

- Spectrex Corp. MD-2
  - rugged, hand-held, lightweight explosive material biometric detection device
- Detects over 40 types of explosives
  - no false positives
  - no maintenance cost
  - no calibration
  - no downtime
- *Fully functional in any environment*

C2 Application: C3Trak



Research Common Information Environment applications in partnership with Mercury Data Systems:

- Enhancing map functionality
- Integration of sensors
- RF Ranging for mobile version
- Human factoring study

Alternative Mobile Power Supplies

- Research of existing alternative power sources
  - Renewable, high-capacity, fuel cell/solar, etc.
  - Feasibility of implementation in military and tactical environments
  - Concept of operations and notional architecture for support to a sensors, communications devices, and other network components

Mini/Micro-UAVs EW Applications

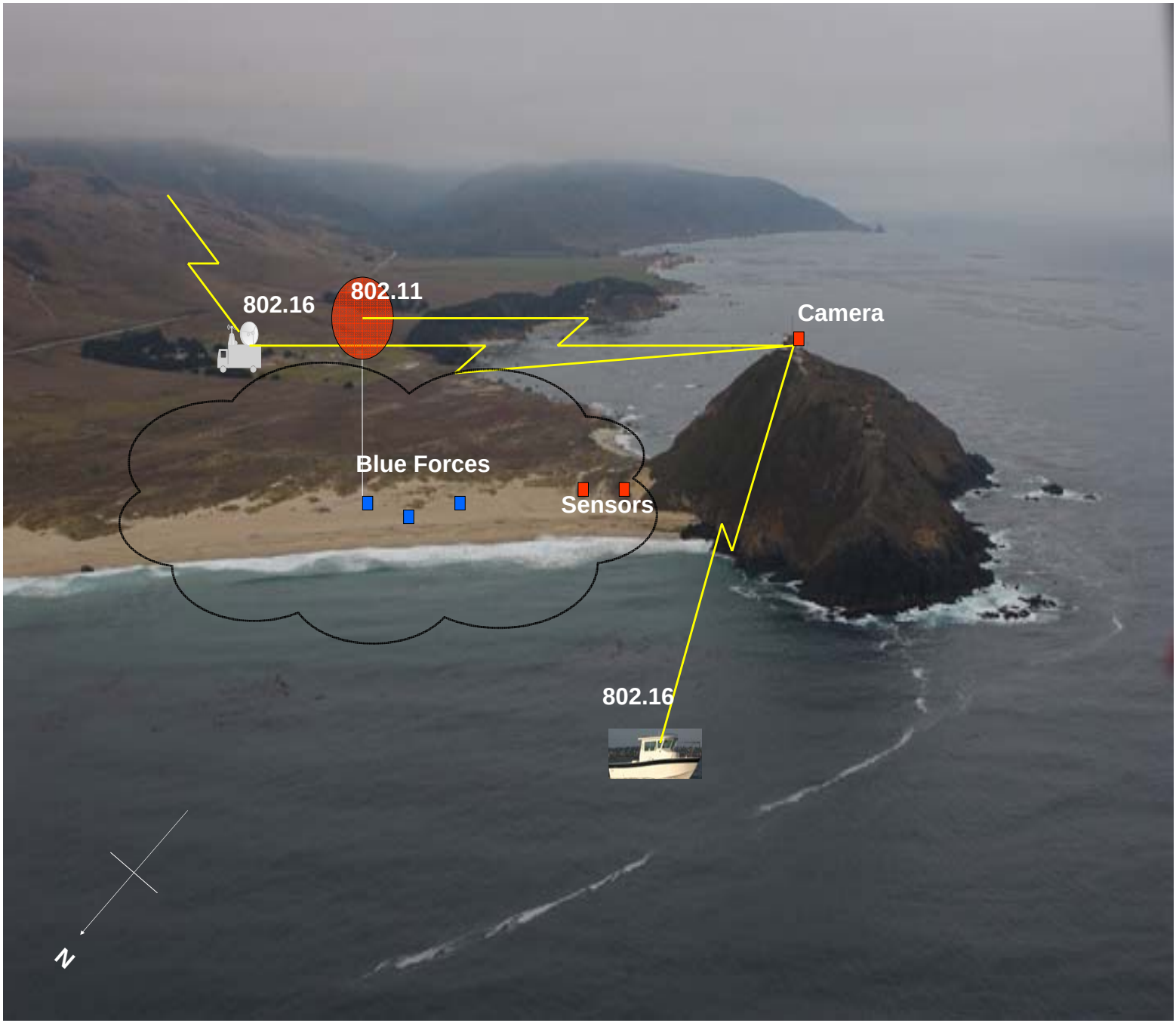
Stand-In Jamming

- Lethality of threat for manned platforms
- Resistance to stand-off jamming through sidelobe suppression
- Ability of UAVs to get close and jam with relatively low power due to range

DRAGON DRONE mini-UAV (USMC)

- **Tactical jammer currently capable against comms (radars?)**
- **20 lb. cargo**
- **NBC sensor**
- **Day or night cameras with laser range finders**
- **Cruise speed 85 mph, max. 115 mph**
- **Range: 35 NM**

COASTS Test I (Pt Sur)



Diverse Challenges Beyond the Technical Realm…

- Network/experiment fragility…less fault tolerant than CONUS-based field experimentation; resource constrained partners and VIP-laden events
- Substantial logistic pitfalls…can't transport many high-duration batteries by comm air; plan for a slow boat ride.
- Force Protection…buddy rule in effect in SEA since 9/11; want to buy a power cord? Better divert two people.
- Physical hardship…20% of team down for entire mission from illness (flu/stomach); start your doxycycline early and often!
- Weather…don't get a "warm fuzzy" just because it worked great at Point Sur.

Notable Quotable

“The vision we seek is: Americans secure at home and abroad; sea and air lanes open and free for the peaceful, productive movement of international commerce; enduring national and international naval relationships that remain strong and true; steadily deepening cooperation among the maritime forces of emerging partner nations; and a combat ready Navy – forward deployed, rotational and surge capable – large enough, agile, enough, and lethal enough to deter any threat and defeat any foe in support of the Joint Force.”

-- CNO Guidance for 2006

Conclusion

- Another step for…
  - regional security and cooperation
  - mutual security & economic interests
  - potential long term cost-savings
  - effective inter-operability exchange and cooperative training opportunity
  - low-level (researcher-to-researcher) way to “push the ball” forward

Other international sponsors desired

Questions?

Mr. James Ehlert
(831) 656-3002
jfehlert@nps.edu