Increasing ROWS Lethality with Optical Weapon Detection Systems

International Infantry & Joint Services
SMALL ARMS SYSTEMS
Symposium, Exhibition & Firing Demonstration

RADIANCE TECHNOLOGIES

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INNOVATION. AGILITY. EXPERIENCE.

Outline

- Background
  - Remotely Operated Systems
- Sensing
- Doctrine
- Weapon Detection Sensor Technology
- Integrated System
- Summary

Remotely Operated Systems

Observations

- Simple, straightforward controls
- Intuitive but restrictive
- Focus on task – lacks distractions
- Tunnel vision
- Lacks Situational Awareness
- FEARLESS

Sensing

- Proprioception -- Sense of self, awareness of position within the environment
- Exteroceptive -- Perception of how outside stimuli are perceived
  - Five Senses (sight, hearing, taste, smell, touch)
  - + (temperature, kinesthetic, pain, balance, acceleration)

- Situational Awareness
  - Intuition
  - Sense of danger or opportunity

- Goal of Sensor Suite -- 'Bring Eyes on Target'
  - See
  - Acquire
  - Target

Doctrine

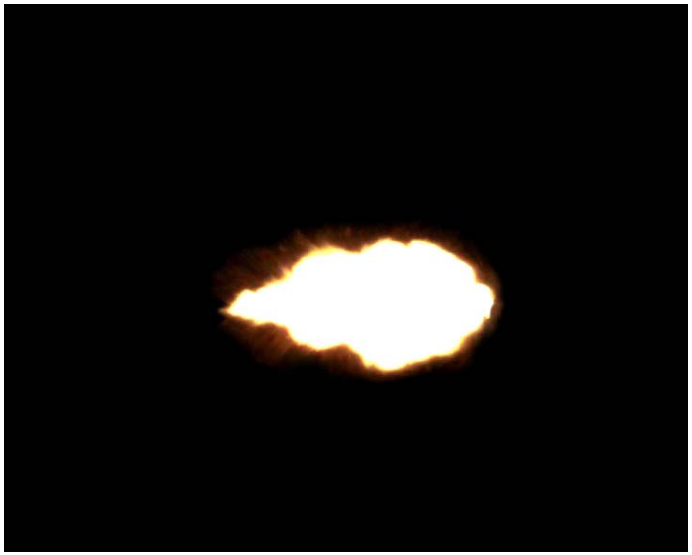
- Kill Chain
  - Find, Fix, Track, Target, Engage, Assess
  - Locate, Identify, Track, Engage
  - Find, Fix, Finish, Follow-through
  - Find the enemy, assess the situation, engage
  - See, acquire and target. The acquire process allows us to determine the engagement or not (Detect, classify, recognize and identify) while targeting determines what degree of engagement is used (aim, point, locate and designate).

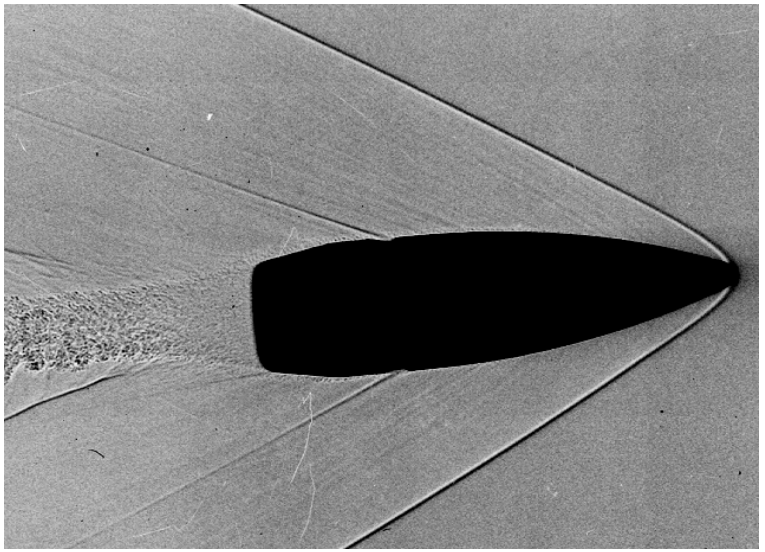
Key to engagement is dependent upon finding the threat/target who is, BTW, camouflaged, covered and concealed

Weapon Detection

1996 Counter Sniper ACTD

Finding: Both acoustic and IR sensors have merit but are plagued by high false alarm rates due to thresholding approach of signature spike





Technological Advances

IR
Signature profiling

Acoustics
Shockwave detection

FLASH -- CRACK -- BANG

Weapon Detection System Description

Sensor and Processing System in Real-Time:

- Broadband MWIR sensor detects, classifies and precisely locates all weapon firing events
- Hypertemporal processing provides robust false alarm rejection and weapon type classification (small arms, RPGs, Mortars, MANPADS, tanks, artillery)
- Open systems architecture facilitates integration with platforms and weapon systems
- Complete situational awareness of weapon firing events for cueing warfighters, countermeasures and counterfire
- Incorporating hostile intent determination

WeaponWatch Ground HFI System

Airborne HFI System

Real-Time Detection, Identification, & Location

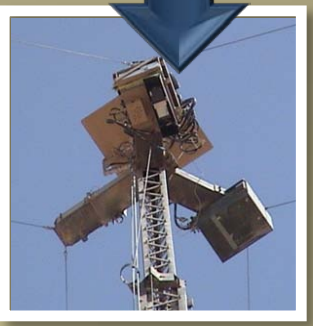
System Applications

WeaponWatch Ground HFI

Deployed since 2004

Overwatch ACTD

Defender Unmanned Ground Vehicle and CROWS-Lite ROWS

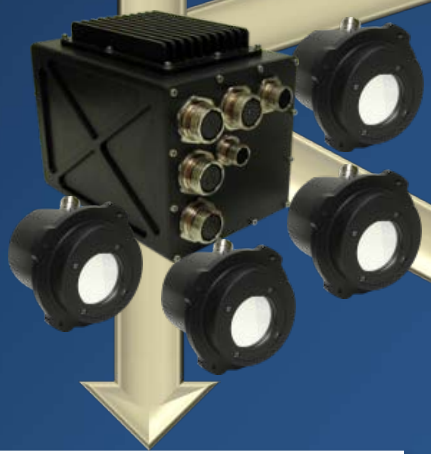


Overwatch on Tower

Airborne HFI System

UH-60 – 1st Airborne Demonstration

Bell 206 – Flight Test Validations



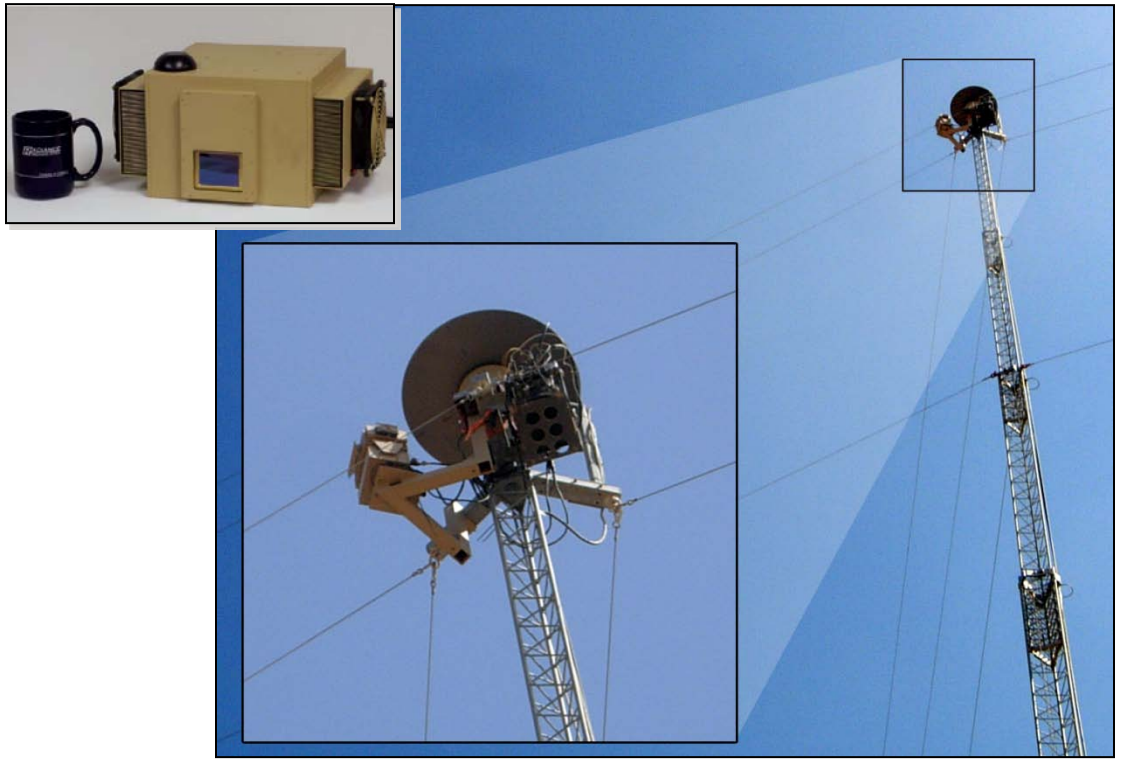
MH-6X –Test Precursor to GFAS

Shadow – Test Precursor to AWSS JCTD

In-Theater WeaponWatch Detections

Remote FOB

- Tripod mounted WeaponWatch units deployed with Special Operations Forces
- While setting up system, base came under rocket attack
- System detected and located shooter who was subsequently captured



"WW detected an event and sent the event message to the RAID Map Overlap which slewed the RAID Camera to the Mortars Point of Origin (POO). The system's operator and the NCOIC observed dissipating smoke from the launch tube due to the speed at which the detection and notification occurred."

NECP 2nd Shift NCOIC

"This system helped out immensely during a time critical operation to find and identify the mortar team while they were still in the area."

NECP 1st Shift NCOIC

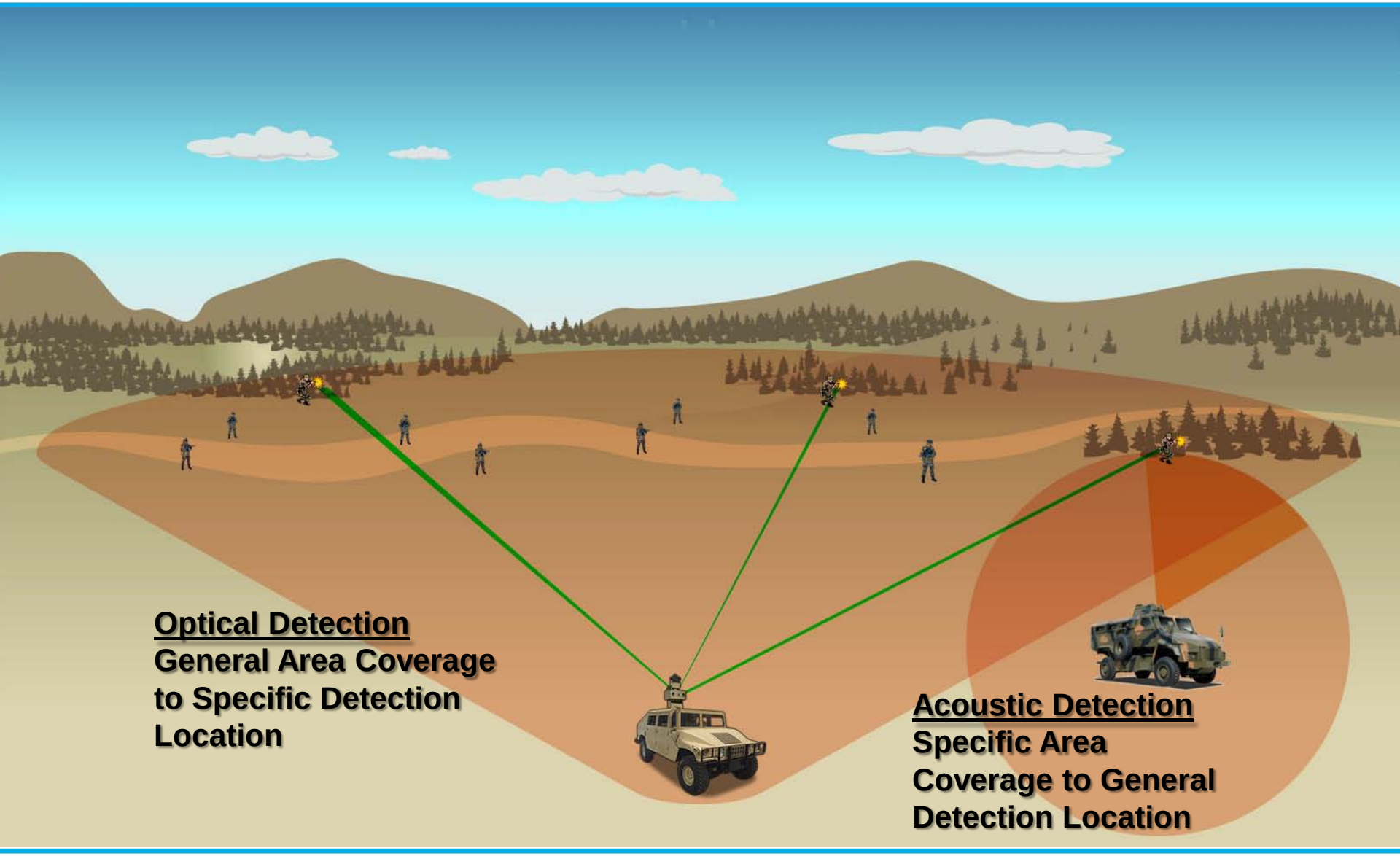
Slew To Cue Applications

- RAID Tower application
  - Slew imager to target location
- WeaponWatch Imaging Strack
  - Similar to RAID tower integration but mounted on a tripod with a dedicated imaging system to 'bring eyes on target' for stand alone applications
- Apache Ground Fire Acquisition System (GFAS)
  - Display on MPD, crew cursor icon, slews MTADS to bring 'eyes on target', gun follows
- Integration with Remote Operated Weapon System (ROWS)
  - Gunslinger—vehicle mounted system
  - Secure Facility -- perimeter security role
- Integration with Common Remotely Operated Weapon System (CROWS)
  - Defender UGV
- Crew Alert Display Development (CADD) (Door Gunner Display)
  - Display shows target location and gun pointing location. Also provides audio cues
- ~Integrated with 360 vision system for rotorcraft—'See through the Hull'
  - Overlay weapon detection icons on helmet mounted display

Needs

- Gunshot Detection System
  - The Gunshot Detection capability increases the Warfighter's individual lethality, survivability, and force protection…
  - The primary mission of the GDS is to rapidly alert the location of the origin of hostile gunfire and provide an accurate location of shooters enabling engagement of targets in all battlefield conditions
  - The current capability gap resides in the inability to detect and locate the origin of hostile fire with accurate range and direction to effectively engage targets
- Threat
  - Enemy combatants use covered and concealed positions to engage friendly forces with small arms or precision small arms fire
  - Trained Snipers are employed in concealed locations and remain undetected until the shot is taken

Inverse Approaches to Gunshot Detection



Integrated Weapon Detection System

WeaponWatch®

Mid-Wave IR weapon detection system. Utilizes hyper-temporal processing to detect and classify events

Acoustic System

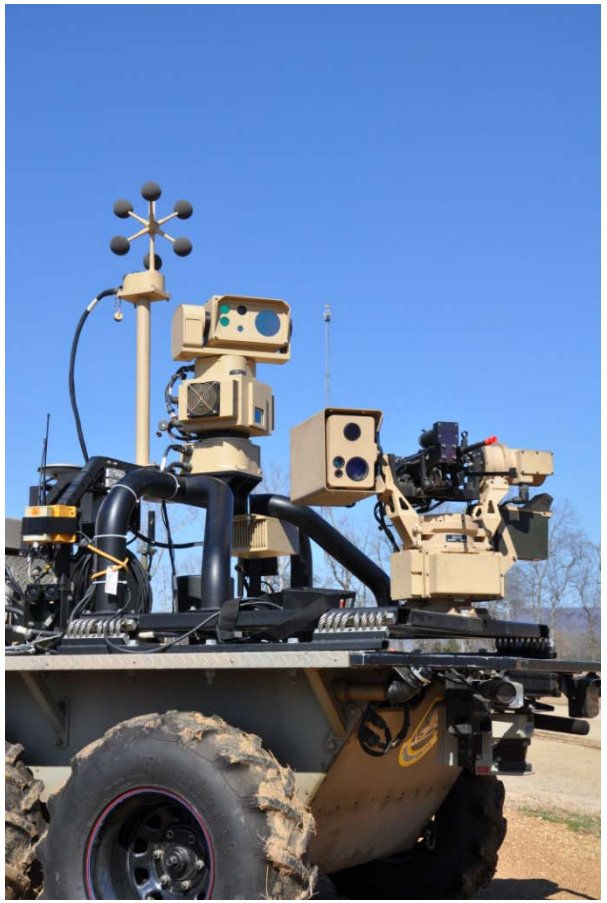
Acoustic hostile fire indicator system. Detects shockwave (crack) of bullet passing sensor array. Correlates with 'bang' for range

Feature	Acoustic	WeaponWatch®	Potential Combined System
Detect all types of weapons	Only supersonic	All	All
Multiple, simultaneous detections	May delay processing	Yes	Yes
Accuracy, az, el	Within degrees	Within fractions of a degree	Fractions of a degree Accurate wpns cue
Accuracy, range	Within a few % of range	No inherent ranging	Demonstrated Flash-Bang correlation better than acoustics alone
Wide field of view	Omni-directional	Directional	Both
Wide area coverage	Only detects rounds passing 10s of m from system	Area Coverage .5 sq km for small arms 4 sq km for RPGs 400 sq km for tanks/arty	Platform protection plus overwatch of dispersed troops
False Alarm Rejection	Shockwave detection	Hyper-temporal processing Stationary-Airborne Ground on the move	Flash-Bang and Flash-Crack correlation for near perfect FA elimination
Weapon Type Classification	Limited	Yes	Yes Increased SA
Hostile Fire Declaration	Yes. Detects round fired at system	No-detects all rounds fired in field of view	Yes Increased SA
Provides Image of the Event	No	Yes. Provides Environmental cues to target location	Yes

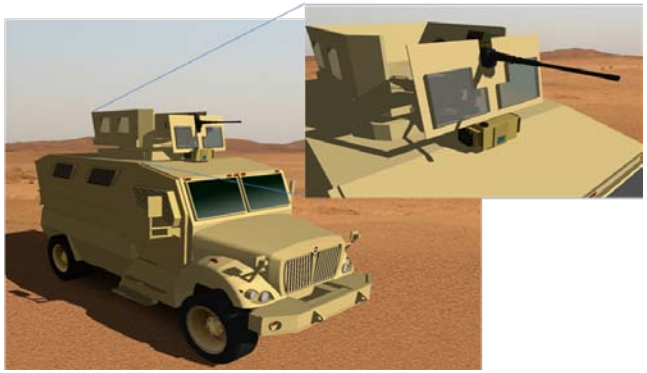
CONOPS

Typically facing likely threat location

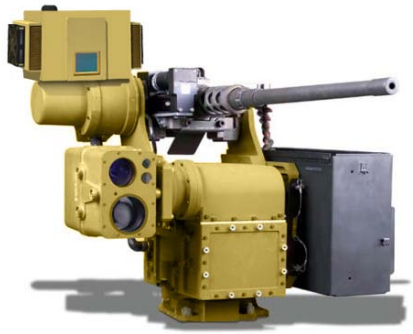
1. Hear shot (acoustic warning sensor)
2. ~~Take Cover~~
3. Face the threat
4. ~~Return fire in the direction of contact (suppressive)~~
5. Assess the situation (optical targeting sensor)
6. Fix the enemy
7. Fire ~~(suppression)~~ and maneuver to close with and destroy the threat (precision fires)



WW Cueing Counterfire



Notional integration concepts for CROWS and vehicle mounted gun system.
Have demonstrated integration and automation with CROWS-Lite under a Force Protection program

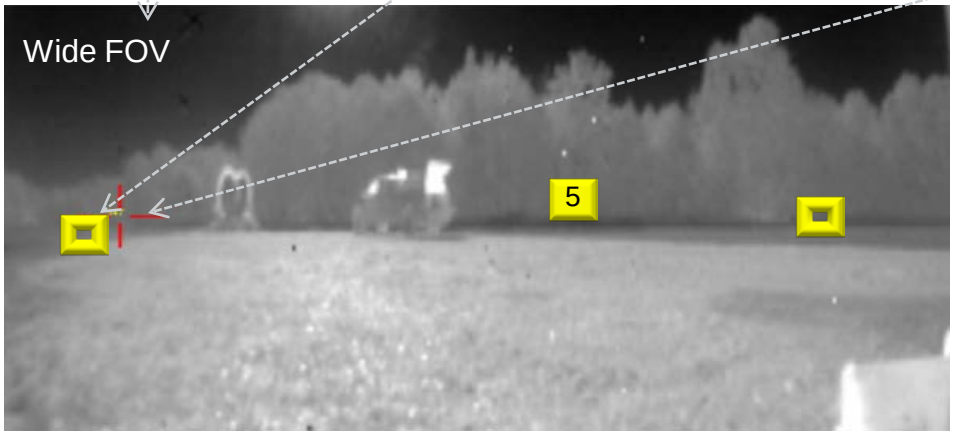


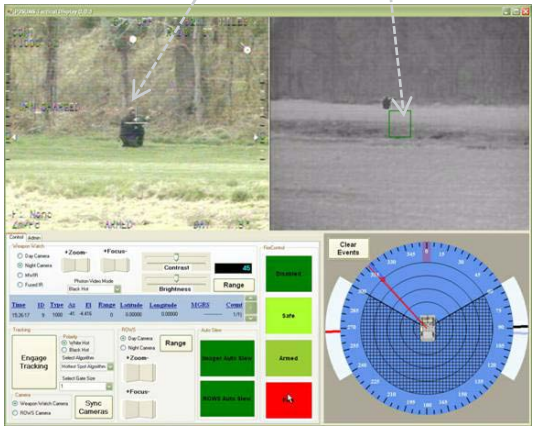
WW provides wide FOV coverage
- Fixed mount or slews with CROWS or weapon system

WW detects, classifies and locates weapon firing
-Icon(s) appears on screen (yellow box)

CROWS operator 'clicks' icon. Az, el passed for auto slew. Manned system -- gunner slews to target location.

CROWS targeting cameras (eyes) brought on target. Operator fine tunes firing solution. Gunner uses sights.





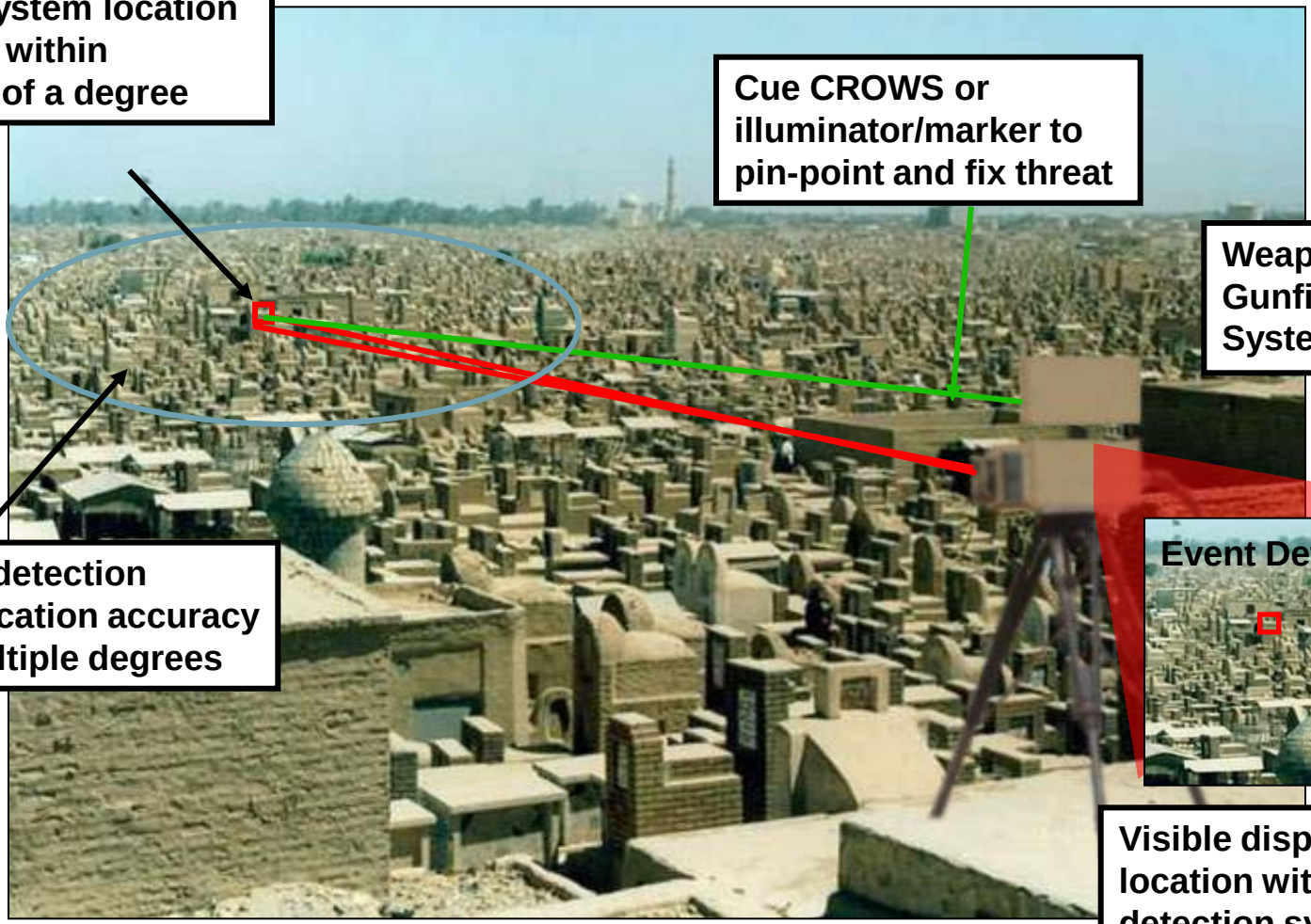
Precise Weapon Detection

Optical Detection Implications:

Precise target acquisition
Instantaneous cueing for threat engagement
Situational Awareness for increased lethality
Move from Suppressive fire to Precision fire
"what window not which building"
Minimizes collateral damage
Not 'keeping heads down' but 'taking heads off'
Reduced logistics footprint

~80% of fire is not aimed. Aiming takes courage and a lot of training. Most shots taken are suppressive
Remote systems are fearless
Ergo ROWS are perfect for this mission and a weapon detection, targeting sensor is a key enabler to maximize system potential

Gunfire Detection Utility Situational Dependency



Apache Crew Comments in OEF

Camp Keating, OCT 2009

"Difficult to find enemy…because of smoke, visibility was restricted to half mile."

"One of the primary reasons the fight took so long, it is in extreme terrain…lots of rocks and cover…can't really detect the enemy until they start moving again."

It wasn't until late afternoon cloud cover moved in that "we were able to see some of the larger muzzle flashes that were a little higher in the mountains, then we started to eliminate the larger weapons." Medevac was unable to arrive until this happened, several hours later.

An integrated GFAS solution will enable Apache crews to quickly acquire and prosecute ground threats

Ground Fire Acquisition System (GFAS)

- CONOPS -- Close Air Support of ground forces
  - Detection icons appear on Multi-Function Display
  - ‘Click’ on icon to slew targeting system to source location--Brings ‘eyes-on-target’
  - Confirm target
  - Proceed with normal engagement process

Gunner Display

Provide Situational Awareness and Targeting information to the Gunner

- Depicts Gunshot Detections relative to gunner position in real time
- Provides audio cues
- Depicts orientation of the weapon at all times for immediate aiming feedback
- Eliminates dependence on external communications

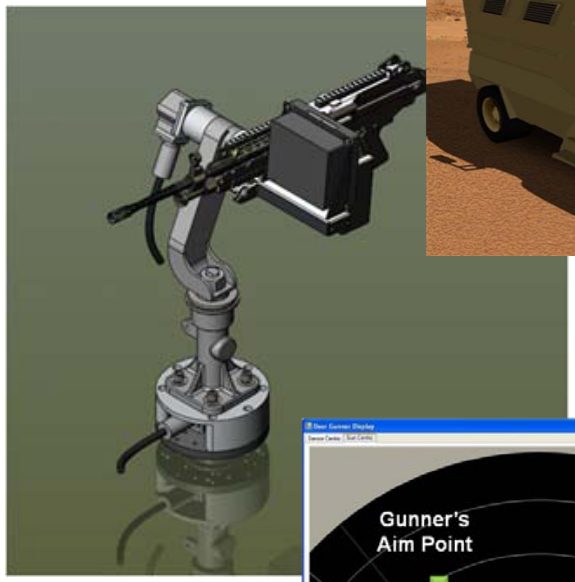


Image with detection icon and gun aim point

Gunner lines up points to acquire target

'Google Earth' Map View—also transmitted to 'Smart Phones'

Increased Lethality Through Real-Time Cueing of Threat Location

Summary

- Optical detection fills capability gap to provide effective, timely and accurate target detection and acquisition
- Enables real time threat engagement with precision fires
- Minimizes collateral damage
- Reduced ammunition logistics
- Proven combat utility and effectiveness for base/perimeter security
- Demonstrated automatic cueing of weapon systems and imagers for multiple applications
- Key to realizing capability is in developing proper TTP and system integration to maximizing system capability and utility

Optical Weapon Detection Makes the Weapon More Effective