Enhanced Expeditionary Engagement Capability

Advanced Capability Extended Range Mortar (ACERM)
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• ACERM is a new precision 81mm mortar cartridge intended for USMC Infantry Battalions
  – Compatible with US Army mortars

• Infantry Fire Support envelope can be expanded to full operating area with Organic Assets
  – 81mm Precision Fires to > 15 km
  – Can keep pace with dynamic/mobile engagements
  – Cost comparable to existing precision fire support

• Key enabling technologies afford additional capabilities
  – Urban Target Engagement
  – Foot Mobile Precision Fires
  – Continued Operations During GPS Denial
E3C Program

• Sponsor:
  – ONR 30 Fires

• Objective:
  – Demonstrate the “Art of the Possible” in fire support technologies for USMC weapons, through an ongoing series of integrated system firing demonstrations

• Structure:
  – Demonstrate systems to TRL 5-6
  – Transition Systems and/or Technologies to Acquisition or FNC programs
  – One new caliber every 3-4 years
  – Flexible to meet future stakeholder needs

First up is 81mm Mortar
Followed by 83mm Shoulder Launched & 60mm Mortar
**Advanced Capability Extended Range Mortar (ACERM)**

- New 81mm Precision AUR
- Dual Mode GPS + SAL Guidance
- >15km Maximum Range

**Miniature Mission Setter (MMS)**

- 2lb Precision Weapon & Fuze Setter
- Logistic Enabler for Foot Mobile Precision

**Low Cost SAL Seeker (LCSS)**

- Enables 1m CEP50
- Eliminates TLE
- GPS Denied Precision Fires

**E3C System**

Precision for Future Infantry Units for both Mounted and Dismounted Operations
ACERM Cartridge

- New 81mm AUR
  - Airframe co-developed by NSWCDD, ARL, & UTC Aerospace
- Ultra Extended Range
  - 10 km (T), 20 km (O)
  - Aerodynamics only, No rocket motor
- Precision Delivery
  - GPS – 10m CEP\(_{50}\) (T), 5m CEP\(_{50}\) (O)
  - SAL – 5m CEP\(_{50}\) (T), 1m CEP\(_{50}\) (O)
- Cost Effective
  - $15k/unit (T), $10k/unit (O)
  - Comparable to existing systems

Extended Range Minimizes Re-Emplacements, Keeps Pace with Mobile/Dynamic Engagements
### Glide Architecture Provides >60% of Range Without Need for Supplemental In-Flight Propulsion

**Launch**
- Mass
- Velocity
- Launch angle
- Drag
- Apogee Alt

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**RG** Gliding Flight Range Extension
- Wing area
- Lift
- Drag

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**RR** Range Reduction
- Target Acquisition
- Terminal Maneuvers

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18-21 km Maximum Range Based on Latest Wind Tunnel Test
• Structures no longer prohibitive to mortar fires
  – Trajectories shaped for Vertical Insertion
    • Byproduct of lift required for extended range
    • More than sufficient capability for Defilade
  – GPS Guidance (10m CEP50) for Open Spaces
    • Courtyards, Intersections, ...
  – SAL Guidance (1m CEP50) for Tight Spaces
    • Streets, Tall buildings, Alleys, ...
    • Airborne platforms provide best designation geometry

• ACERM is agnostic to terrain type
  – Works in Urban, Mountain, Canyon, & Defilade

Allows 81mm Mortar Fire Support to return to Engagements in Urban Terrain
- Precision + Flight Path Control + Advanced Warhead Technology = **Expanded Target Set**

  - <10m CEP50 reduces need for large warhead
    - Reduced Collateral Damage

  - Vertical flight path at detonation
    - Optimal warhead orientation relative to target

  - Increases ECR with less HE than M821/889
    - High Density Pre-Formed Fragments
    - Tuned for delivery accuracy and target set
    - Optional upgrade to Reactive Materials
• Capability beyond traditional GPS Anti-Jam
  – SAL Guidance Mode
    • Any STANAG 3733 designator system
      – PLDR, JTAC-LTD, Fixed Wing, Rotary, UAS, ...
  – Standard 81mm Ranges (< 6km)
    • Mortar aimed for traditional ballistic intercept
    • Future upgrade for extended ranges
      – Upgraded IMU required
  – Even during an MMS Casualty
    • No electronic systems required at mortar to conduct precision missions

**Precision Organic Infantry Fires Possible Even During Periods of Full GPS Denial**

Joint Terminal Attack Controller Lightweight Target Designator JTAC-LTD (AN/PEQ-19)
Low-Cost SAL Seeker (LCSS)

**LCSS v2**
- STANAG 3733 SAL Targeting Sensor
- 0.5 lb, 6.3 in³
- Capable down to 10 mJ/pulse
- External Projectile Sub-System
- Hardened to 10 kgee’s
- Est. $1k unit @ 10k rate
- 19 prototypes delivered

**LCSS v3**
- LCSS V2 Capabilities +
- 0.3 lb, 4.0 in³
- Internal Projectile Sub-System
  - Optics must be ported
- Embedded Ranging Sensor for Precision HOB
  - 1-20m Selectable w/ 3.5% err.

**LCSS v4**
- LCSS V3 Capabilities +
- 0.3 lb, 4.0 in³
- Guidance Processor
- Inertial Sensor Suite
- Additional I/O for CAS, Fuze, and Other Guided Projectile Subsystems

Future Development Will Yield LCSS v2 Capabilities in 80% Smaller Form Factor

Now

FY 16

FY 18

Coming Soon
Miniature Mission Setter (MMS)

- **Man Portable System**
  - Enables smaller PGMs and Foot Mobile Precision
  - Weight < 2 lbs
  - Originally sized to fit in USMC cargo pocket

- **Improved Power Efficiency**
  - Direct Contact Interface
  - New Environmentally rugged connector under development

- **Android Interface**
  - Intuitive and familiar
  - Minimal input required from users.
  - Expansion to host additional apps (mapping, force tracking, mission planning, intel)

- **EPIAFS Backwards Compatibility**
  - Already generates same data message format
  - Inductive setter output through Legacy Compatibly Kit

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**Current MMS Components:**
- Android Handheld
- Embedded SAASM GPS
- Crypto Storage/Handling
- Rugged Round Connector
- High Power Battery
- Radio (optional)

**PLUMSS:** 40 lbm, 3120 in³

**MMS:** 2 lbm, 50 in³
Demonstration Schedule


Distribution Statement A

PR#4503 is Approved for Distribution Statement A: Approved for Public Release; distribution is unlimited.

**Demonstration Schedule**

**FY 14**
- Hardware-in-the-Loop Testing (UTC Aerospace Systems)
- Wind Tunnel Testing (NIAR, Wichita State University)

**FY 15**
- Live Fire Testing (Yuma Proving Grounds)
- Live Warhead Testing (Aerojet Rocketdyne)
- Miniature Mission Setter (MMS) Integration (GD-OTS)

**FY 16**
- JTAC-LTD & Skylark I-LE UAS (Elbit Systems of America)
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**Future**
- TRL 6 Demonstrations in FY16

ACERM Air

• Minimal Update to Become UAS Dropped Munition
  – Fuze Arming Environments
  – Fuze Setter Interface → Aircraft Umbilical
  – Remove Launch Energetics

• Creates SDB style capability for UAS
  – 10 – 20 km glide range (altitude dependent)
  – 1m CEP_{50} Precision
    • Using onboard SAL Targeting
  – Maintenance of ISR orbit while engaging targets
  – Airborne designation CONOPS for ground launched ACERM

End-to-End Engagement Capability on Single Platform
• **eXtreme Performance Configuration**
  - 40 – 60 km Maximum Range
    - Long Range Precision from low cost portable launcher
  - TOF to 15 km reduced to 120 sec
    - Increased responsiveness for Organic Infantry Fire Support
  - **Multiple Round Simultaneous Impact (MRSI) & Firing Patterns**
    - From single 81mm mortar tube
  - **Moving/Maneuvering Targets**
    - More responsive to dynamic engagements

• **Key Enabling Technologies**
  - Supplemental in-flight propulsion
    - Rocket Motor
  - **Discarding Launch Propulsion**
    - Improves aerodynamic contour
    - Enables simpler rocket motor nozzle geometry
  - **Enhanced GNC & Fire Control**
    - Onboard ACERM and MMS

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**Looking for Additional Industry Input through DOTC Topic ENT-16-01**
Conclusions

• ACERM can expand Infantry Fire Support Envelope with Organic Assets
  – 81mm Precision Fires to >15 km
  – Can keep pace with dynamic/mobile engagements
  – Cost Comparable to Existing Precision Fire Support

• As Part of E3C System
  – Urban Terrain Engagements
  – Continued Operations During GPS Denial
  – Foot Mobile Precision

• Future ACERM Capabilities
  – Air-Dropped Variant for UAS with SDB Style Capabilities
  – Ultra Extended Range (>40 km)
  – Moving Targets
  – MRSI Fires
• Questions?