



ENHANCED EXPEDITIONARY



ENGAGEMENT CAPABILITY

Moving Target Artillery Round (MTAR)
2016 NDIA Armament Systems Forum

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25-28 Apr 2016



- Long Range Precision Fires Maritime (LRPF-M) Deliberate Universal Needs Statement (D-UNS)
 - Requests critically needed additional warfighting capability
 - Expanded Artillery Fires to include:
 - Increased Maximum Range, Moving Targets on Land/Sea, Satellite/Network Denied Environment
 - From either M777 155mm Howitzer or HIMARS
 - Approved 30 Dec 2015

- Moving Target Artillery Round (MTAR)
 - ONR 30 Development & Demonstration of 155mm Solution
 - 6 Year Effort Starting Now
 - 3 Year 6.2/6.3 S&T Program (FY16-18)
 - 3 Year Future Naval Capability (FNC) Program (FY19-21)

- Enhanced Expeditionary Engagement Capability (E3C)
- 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 155mm Artillery & 60mm Mortar**

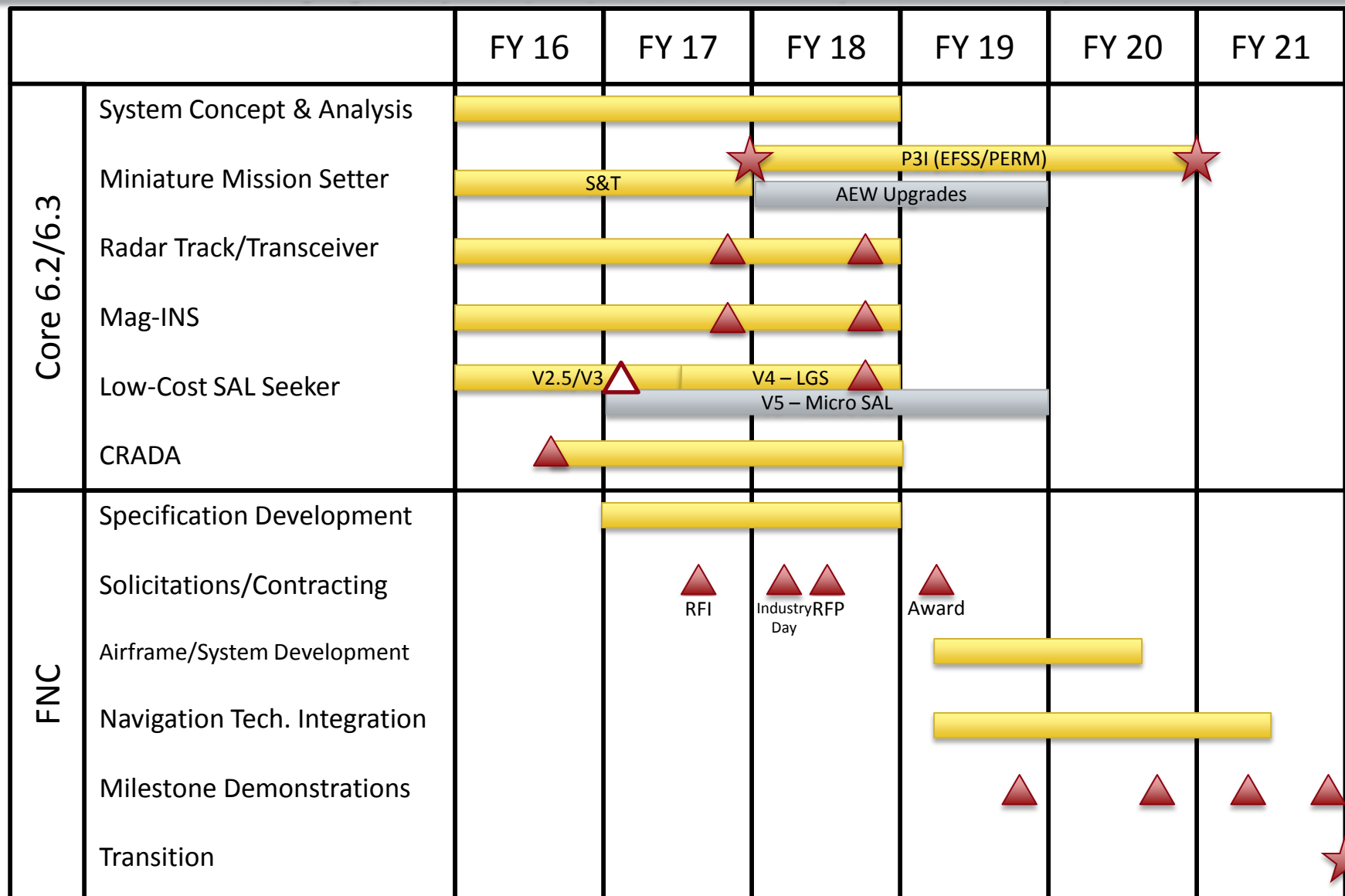




MTAR Schedule



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- Satellite/Network Denied Navigation Technologies
 - Highest Risk/Least Mature of 3 KPPs
 - Specifically geared for GPS DNE and moving targets
 - Mature suite of technologies for integration in MTAR Airframe
 - Demonstrate through series of lab and gunfire tests
- Baseline MTAR Navigation Suite

Flight Phase	System
Pre-Launch	Miniature Mission Setter (MMS)
Early Flight	Radar Track/Transceiver
Mid-Course	Magnetically Aided Inertial Navigation (Mag-INS)
Terminal	Low-Cost SAL Seeker

**Navigation Technologies available to MTAR Developers
for Integration into System Solution**

Miniature Mission Setter

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(MIMS)

- **Man Portable System**
 - Enables smaller PGMs and Foot Mobile Precision
 - Weight < 4lbs
 - Leverages 8" Tablet Computer from Target Handoff System (THS)
- **Improved Power Efficiency**
 - Direct Contact Interface
 - Environmentally Rugged Connector Developed
- **Android Open Architecture Touchscreen Interface**
 - Intuitive and familiar
 - Minimal User Input Required
 - 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

Partnering with MARCORSYSCOM to Mature MMS as logistic enhancement for Expeditionary Fire Control System (EFCS)

Provides Pre-Launch Power and Off-Projectile Computational Resources for MTAR



PLUMSS: 40 lbm, 3120 in³



MMS: <4 lbm, 100 in³

- Current MMS Features:**
- Android Tablet (8" Screen)
 - Embedded SAASM GPS
 - Crypto Storage/Handling
 - Rugged Weapon Connector
 - High Power Battery
 - Two-Wire/Tac-Link Modem

- Radar Track & Transceiver
 - Small form factor tracking radar w/ up-link broadcast
 - Co-Located with M777, maintained by gun crew
 - Uplinks Pseudo-PNT data to multiple outbound MTAR projectiles
 - Antenna and Transceiver in MTAR projectile Guidance System
 - Receives Radar Station Broadcast
 - Down-links Health/Status Information
 - Combination corrects for initial condition errors & calibrates INS
 - Allows gun captain immediate dud recognition
 - Link will break at pre-determined point in trajectory
- Magnetically Aided Inertial Navigation (Mag-INS)
 - Provides mid-course navigation solution
 - Sufficient to reach terminal seeker acquisition basket
 - Low Cost Discrete Component Architecture
 - COTS sensor arrays with advanced mathematical filters
 - Magnetometers provide additional observable environment
 - Mitigates rate sensor bias and reduces rate sensor drift

**Contract Award
Pending**

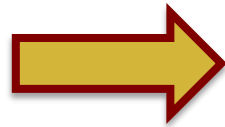
Low-Cost SAL Seeker (LCSS)

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Now

FY 16

FY 18



Coming Soon

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
- 35 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.
- 2 prototypes ordered

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

MTAR Research will improve Signal Acquisition Range and FOV to meet GPS DNE Navigation Needs

- Development & Demonstration of MTAR System
 - TRL 4 Entry Criteria, 3 Year Effort
 - Four (4) planned firing milestone demonstrations
 - 1 for each KPP, 1 Capstone Capability Demonstration
 - Engineering firing tests as required
 - Transition TRL 6 System to MARCORSYSCOM for Acquisition
- Soliciting Industry for Technology Solutions & Prototypes
 - Airframe/Payload(HE) is minimum need
 - ONR Developed Satellite/Network Denied Navigation Technology will be available for integration (if needed)
 - Alternative sub-system solutions encouraged
 - Planning to use NAC/DOTC for contracting

**MTAR FNC Endorsed by I MEF, II MEF, III MEF, CD&I,
& MARCORSYSCOM PdM AFSS**

- KPP-1: Maximum Range
 - 70km (T) – 100 km (O), from unmodified M777 with MACS
 - Must meet System Effectiveness KSA at range

- KPP-2: Moving Targets
 - Land Targets: M982 Target Set (T), TBD (O)
 - Sea Surface Targets: FAC/FIAC (T), TBD (O)
 - Targets may displace from original location, be moving during intercept

- KPP-3: Satellite/Network Denied Environment
 - Assume Global Position System (GPS) **Does Not Exist (DNE)**
 - Limited Network Access
 - Intra-Battery and Forward Observer (FO) Communications Only
 - No Feed Forward of GPS Ephemeris/Almanac Data
 - Must still meet KPP-1 & 2

Requirements & Performance Specifications will continue to be refined prior to RFP Solicitation

- KSA-1: System Effectiveness
 - M982 Excalibur Effects on Target (T)
 - Area Effects Weapon (AEW) Replacement Effects on Target (O)

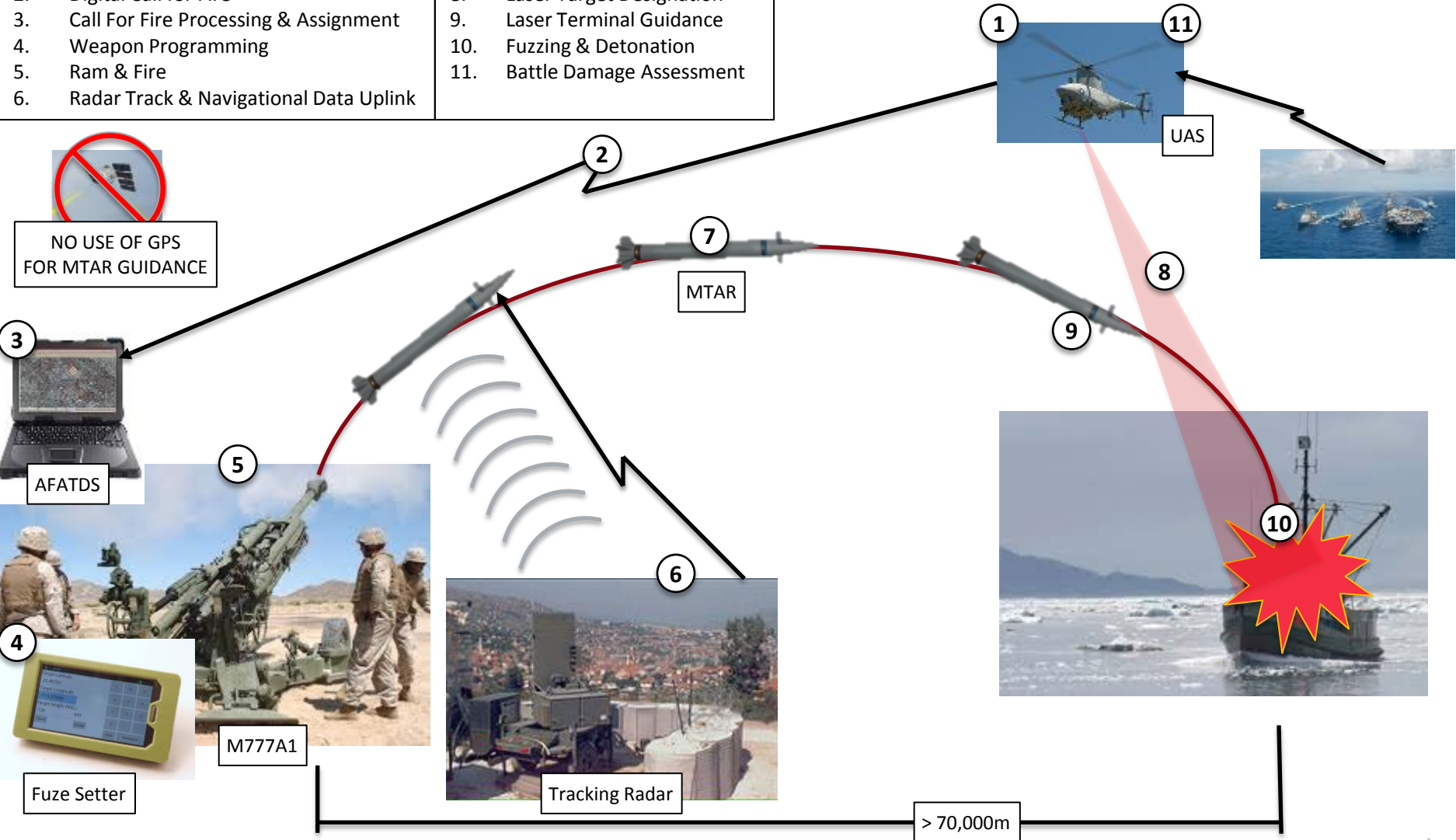
- KSA-2: Modular Architecture
 - Key Sub-Systems should be “Plug & Play”,
 - Terminal Seeker (T), Payload (T)
 - Selectable during Factory Assembly
 - Open Architecture Interfaces to Enable Future Growth

- KSA-3: Affordability
 - System not relevant if not cost effective (Bullet Pricing not Missile)
 - Use of low cost technologies a must

- KSA-4: Responsiveness
 - Time on Target is critical to successful fire support
 - Pre-Launch process also critical: Fuze Setting, Ramming, ...

1. Target ID, Track, Classification
2. Digital Call for Fire
3. Call For Fire Processing & Assignment
4. Weapon Programming
5. Ram & Fire
6. Radar Track & Navigational Data Uplink

7. Inertial Midcourse Guidance
8. Laser Target Designation
9. Laser Terminal Guidance
10. Fuzzing & Detonation
11. Battle Damage Assessment



Exploring Joint Service SOLUTIONS

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- Design Requirements comparable or greater to USN and US Army stated requirements/gaps
 - Maximum range requirements of at least 40km+
 - Objective requirements for moving targets
- Multi-Service Procurement = Lower Unit Cost
 - Leverage economies of scale on 90% common solution
 - Modular architecture will enable service specific needs
- Active Consideration of 5-Inch Solution
 - More than Doubles Launch Tubes w/in Department of Navy
 - Leverages continued USN Technology Investments
 - Saboted to 155mm for M777 (USMC & US Army)
 - Lower ballistic coefficient will aid in making range



Conclusions

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- MTAR working to meet gaps stated in LRPF-M D-UNS with 155mm Howitzer Solution
 - Artillery Fires to 70 – 100 km
 - Moving targets afloat/ashore
 - Operations in Satellite/Network Denied Environment
- Potential for Joint Service Solution
 - 5-Inch Variant Saboted to 155mm
 - USMC, USN, & US Army capability
- New Start FNC Program in FY19
 - Endorsed by Key USMC Organizations
 - Major Industry Opportunity for Airframe, Payload, and System Integration

**Research into
Navigation without GPS
Ongoing Now**

**New Start FNC Program
in FY19 for Integrated
Solution**