



*U.S. Navy Spike Missile System: A
New Generation of Miniature
Precision Guided Weapons*

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Background

- Engage “asymmetric” aggressors in complex urban and rural environments; weapons have to be high precision, low collateral damage systems to minimize civilian victims
- To meet these needs, a new class of missile system is necessary. It must be a modular, cheap, lightweight, high precision missile system
- This paper will cover system, technology and design approach aspects of the USN Spike missile project, an innovative, low cost, precision guided missile system



How We Are Doing It

- Spike treated like a commodity
- Development
 - Extensive warfighter interaction and validation
 - 80% vice 100% solution and affordable (get most of the capability to the warriors ASAP)
 - ◆ Cost is highest priority design factor
 - ◆ Weight & Volume
 - ◆ Performance
 - Navy - Industry partnership from the start
 - ◆ Navy laboratory team leads system development
 - ◆ Industry partner engineers for high volume manufacturing
- Manufacturing
 - Navy owned data package
 - System Assembler (No traditional prime contractor)
 - ◆ No missile manufacturing expertise required
 - ◆ 2nd & 3rd tier (defense) contractors
 - Smart use of COTS in a military application
 - ◆ Modular design
 - ◆ Add additional capability through spiral developments
 - ◆ Production line set up for change



Programmatic Goals



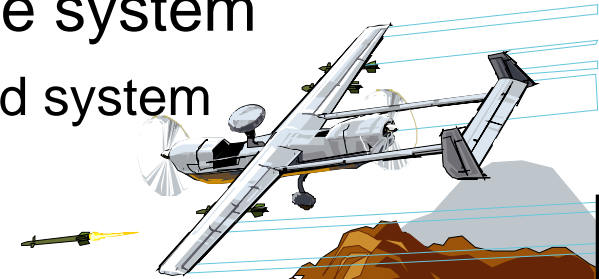
	Spike	Typical
■ X10 reduction in unit cost	\$5K	>\$75K
■ X5 reduction in development cost	\$75M	\$0.5-1.2B
■ X3-4 reduction in SDD time	2-3 years	12-16 years



What is Spike?

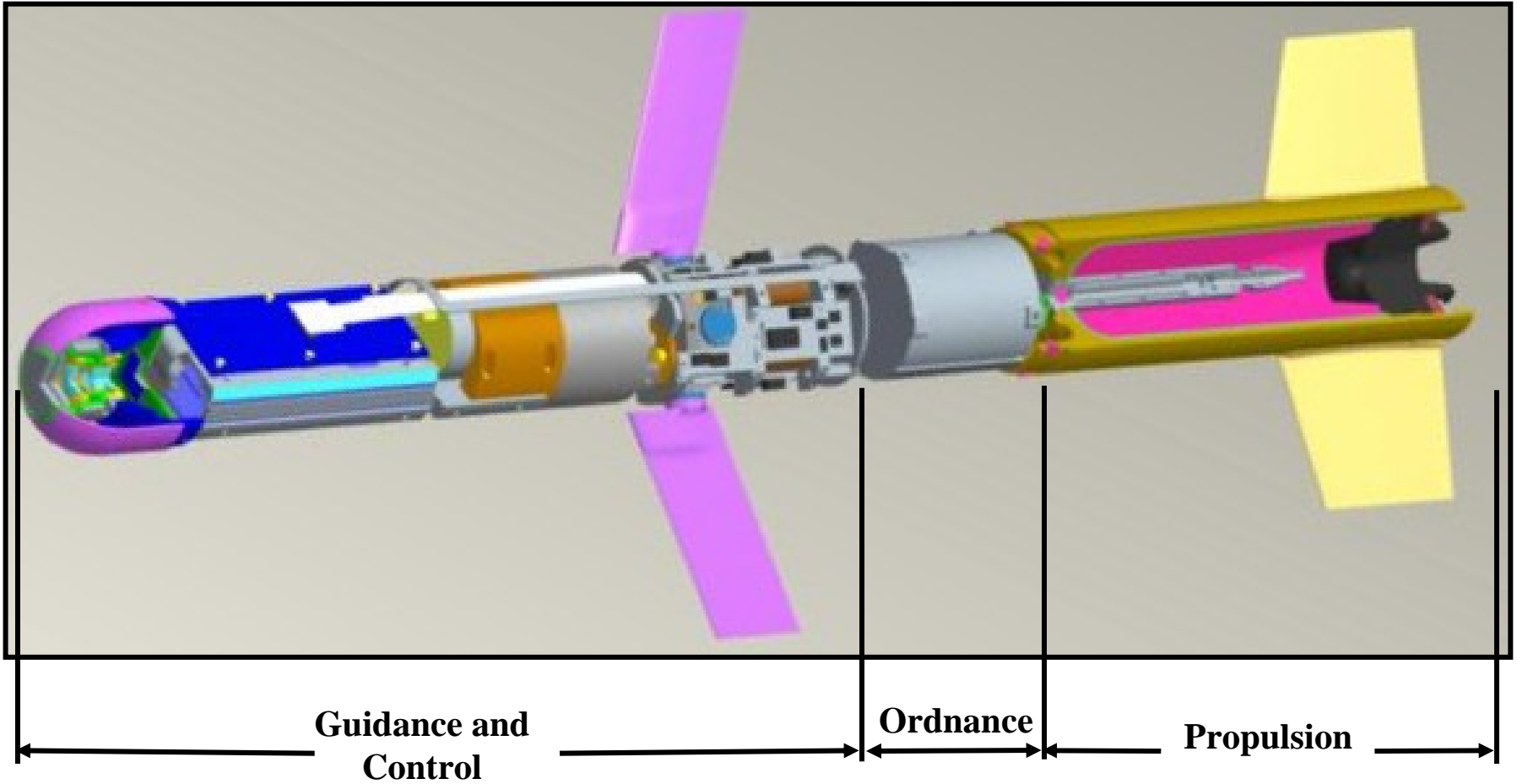
Small fire and forget precision guided missile system

- Shoulder, tactical UAV, or UGV/boat/ship launched system
- General purpose electro-optical (EO) seeker
- Lightweight system - goal of 5 lb./missile
- Smart use of COTS in military application
- Affordable - goal - \$5K/missile
- "80% solution"



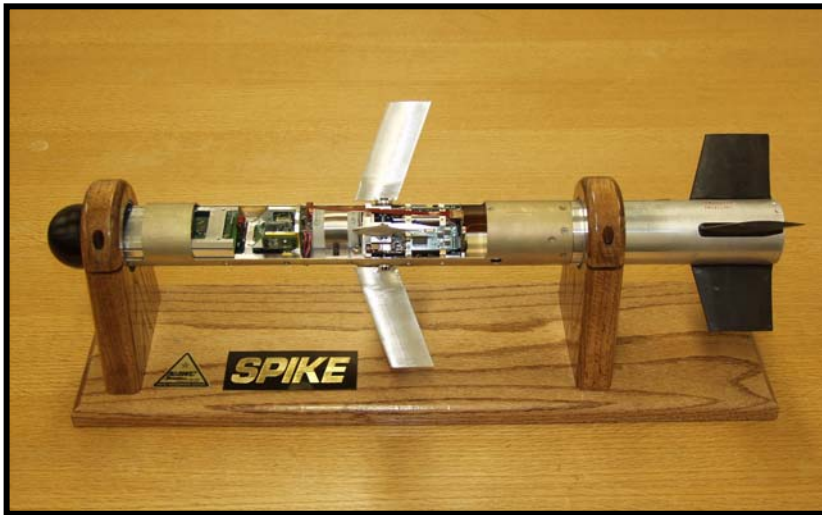


Modular System Design



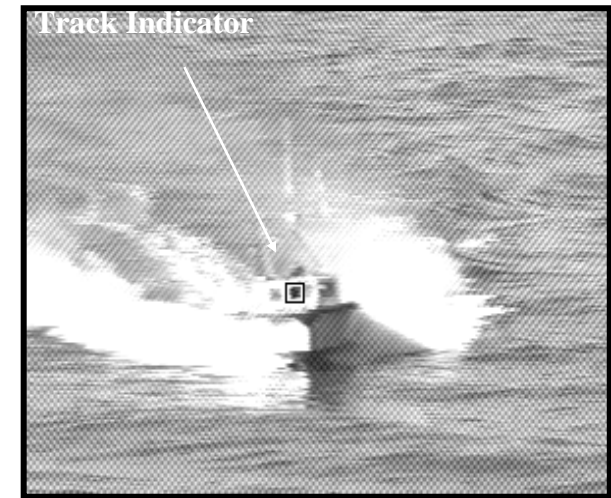


Spike Missile Performance



■ Low Cost Highly Effective Precision Guided Missile

- Total weight ≈ 5 lbs
- Warhead ≈ 1 lb EFP
- Range ≈ 2+ miles
- Max flight velocity ≈ 800 ft/sec
- Cost ≈ \$5K AUPC
- Seeker EO or Laser spot



■ Highlights

- Fire and Forget
- Fire from enclosure - minimal backblast
- Precision guidance ideal for littoral and urban environments - minimizes collateral damage
- Designed for flexible manufacturing
- Ready for production in 2 years



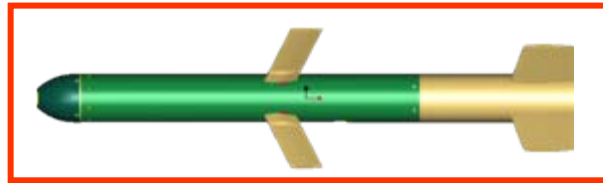
Spike Warhead Performance



- 1 lb. explosively formed projectile warhead
- Copper liner, magnesium and steel fragmentation wrap



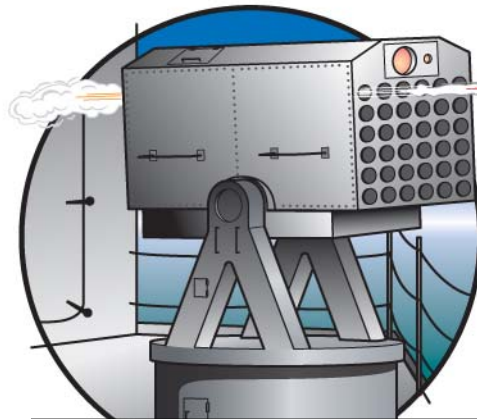
Spike Launchers



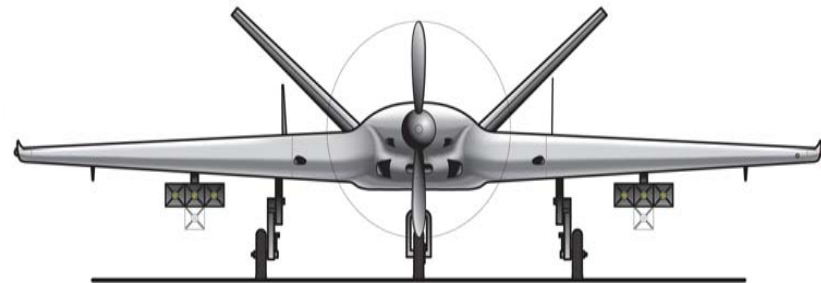
- Common missile
- Multiple launchers



Shoulder



Remotely
Controlled Box



TUAV



Accomplishments

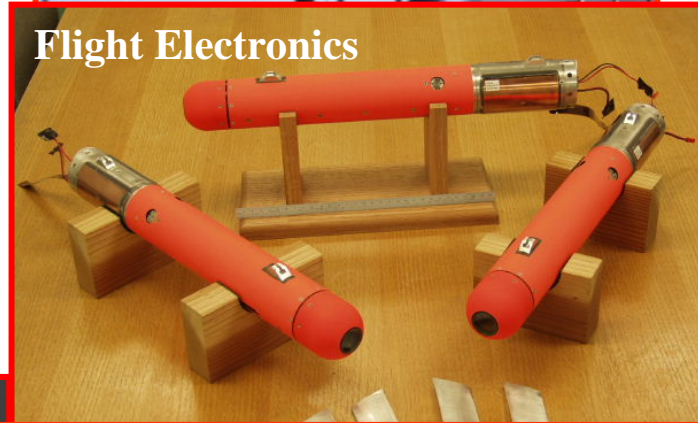


- Wind tunnel tests
- Target acquisition/track testing
- Preliminary rail launch test firing
- Separation Control Test Vehicle (SCTV) missile firings (3)
- Separation Control Test Vehicle (SCTV) missile firings (2)
- Four warhead lethality tests
- Guided missile test

SCTV Test



Flight Electronics



Guidance Test



Tracker Test



Warhead Test



Asymmetric Threat Target Set



- Target characteristics
 - Large numbers
 - Low cost
 - mobile
- Targets
 - Small boats
 - Un-armored vehicles
 - Lightly armored vehicles
 - Machine gun emplacements
 - General aviation
 - Helicopters



Program Measures of Effectiveness



- Cost
 - Live fire training
 - Deploy with large numbers
 - Recurring, non-recurring, life-cycle
- Tactical utility
 - Can get it to the fight-weight, volume
 - Value
- Performance
 - Precision guided
 - Low collateral damage
 - Engage maneuvering targets



Cost Drivers



- Control requirements
 - Adequate performance not perfect
- Technology availability
- Control system complexity drivers
 - Lock-on-before-launch (LOBL)
 - Resolved targets
 - Gunner verification of correct target acquisition
 - Results in $\approx 90\%$ reduction in target acquisition/track processor throughput requirements



Technology Trades



- Strapped down target acquisition sensor
 - Advance CMOS focal plane array (FPA)
 - Fast optics
 - Ultra-stiff airframe
 - Low maneuverability target set
- Simplify tracker/guidance system architecture-low cost
 - Modular electronics design (power, ground, serial data bus)
 - Lock-on-before-launch (LOBL)
 - Gunner target acquisition verification
- Ordnance section
 - Contact only fuze
- Rocket motor
 - Moderate performance
- **Result: low cost missile**



Weapon Utility

- Low enough cost to procure in large numbers for use against low cost targets
- Low cost enough to allow for training
- Light weight (5 lb.) enough to get it to the fight
- Can engage time critical fixed and maneuvering targets
- Precision guided weapon - low collateral damage
 - Ideal for urban battle field and littoral defense
- Easily adapts to several requirements/needs
 - UAV/UGV/USV armament
 - Shoulder launched ground force weapon



Summary



- How we are doing it
- Spike missile system
 - Low cost, light weight, low collateral damage
 - Low cost enough for training
- Flexible use
 - TUAU/USV/UGV/Shoulder
- Provides battlefield versatility for the individual warfighter to engage asymmetric threats