

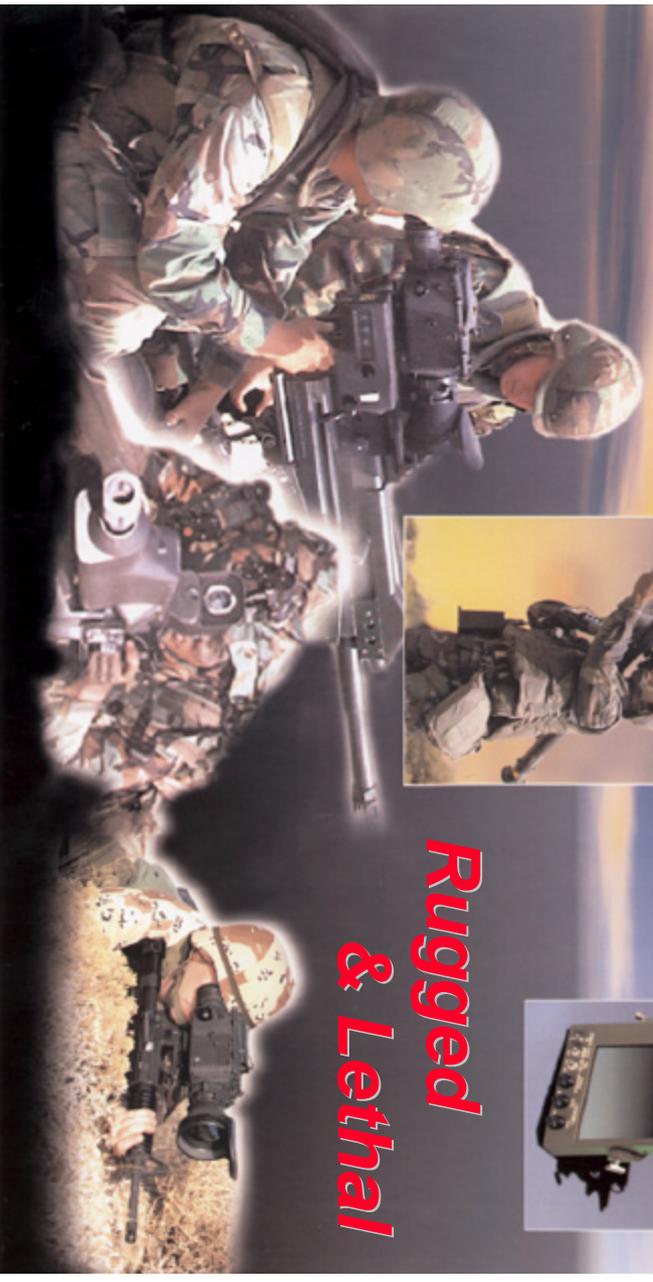
Light Infantry Weapon Fire Control System

Chuck Nourrcier

Raytheon Electronic Systems

Cnourrcier@raytheon.com

972 344 4857



**Rugged
& Lethal**

Small Arms

Fire Control Systems & Thermal Sights

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NDIA

**2001 Joint Services Small
Arms Symposium**

13 - 16 Aug 2001

Little Rock, AK

*Robin Wohlman
1/27/00*

Manportable Cameras, Sights & Fire Controls



W1000 Thermal
Rifle Sight



TWS



ISM



LRF/DCA



IR Lookout
(MAG-2400)



Stinger Night
Sight (SNS)

TWS MBS

Leverage:

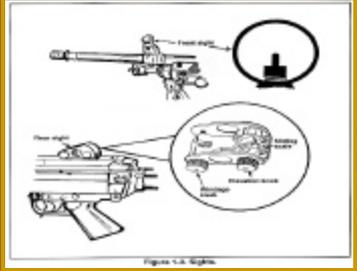
- Components
- Small Arms Experience
- Common Logistics
- Systems Engineering & Technology

Raytheon



Rugged and Lethal !

Evolution of the OCSW Target Acquisition & Fire Control System



I² Rifle Sight



TWS



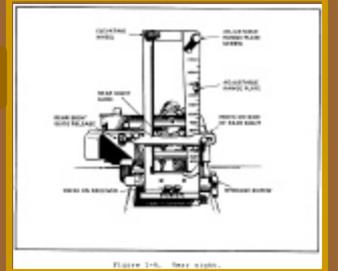
Laser



TWS/MBS



OCSW TA/FCS



OCSW



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Thermal Weapon Sights



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Handheld, Weapon Mounted up to .50 Caliber or grenade launchers

System

- **2-to-1 Electronic Zoom**
- 3 - 5 μm (Mid-wave Infrared) spectral band
- **TDI Scanning MCT 40 x 16 FPA detector**
- 6-Stage Thermal Electric Cooled
- **>3 1/2 hour mission profile/battery life with BA-5347 battery (compatible with AA Lithium or Alkaline)**
- 120 seconds (3 seconds from stand-by) operational ready time
- **RS -170 video output (for monitors or recorder)**
- External power from 11-40 VDC external source with adapter
- **Selectable reticle patterns**

Lens options define the performance of the system.

	<u>Medium</u>	<u>Heavy</u>
Dual FOV Lens		
Narrow	6	3
Wide	18	9
Magnification		
Narrow FOV	5X	10X
Wide FOV	1.7X	3.3X
Range (meters)		
Vehicle		
Detection (WFOV)	1000	2240
Detection (NFOV)	2740	5640
Recognition (NFOV)	1000	2240
Identification (NFOV)	530	1150
Personnel		
Detect/Recg (WFOV)	470	1000
Detect/Recg (NFOV)	1290	2810
Size (cm)		
Length	40	46
Width	16	16
Height	16	16
Weight (kg.) incl. Battery	2.3	2.5



Medium
6° x 18°

Heavy 3° x 9°

Customers:

- US Army/Marines/Special Ops
- United Kingdom, Germany, Australia, Sweden

Availability

- In-Production

Handheld Surveillance or Weapon Mounted (up to 7.62mm (.308cal) guns)

System

- Long Wavelength (8-12um) spectral band
- **320x240 BST uncooled FPA detector**
- 8 hours life on BB-2847 rechargeable batteries (compatible with AA Lithium or Alkaline)
- **less than 60 second operational ready time**
- external power (7 to 40 volts DC)
- **RS-170 video output (for monitors or recorders)**
- **Selectable reticle patterns**

Lens options define the performance of the system.

	<u>15° FOV</u>	<u>9° FOV</u>
Magnification	1.8X	3.1X
Range (meters)		
Vehicle		
Detection	1400	2390
Recognition	480	800
Identification	260	400
Personnel		
Detect/Recognition	610	1040
Size (cm)		
Length	33	36
Width	10	11
Height	11	12
Weight (kg.) incl. Battery	1.6	1.7



Customers:

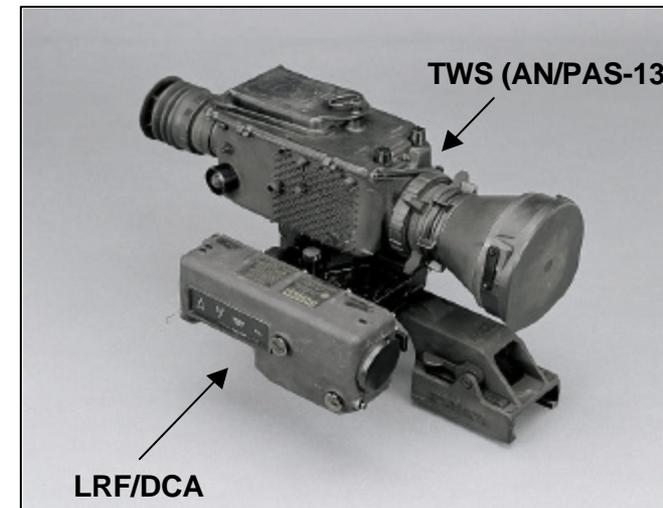
- US Army/Navy/AF/Marines/Special Ops
- Turkey, United Kingdom, Israel, Denmark, Japan, Germany, Australia, UAE
- In-Country licensed manufacturing

Availability

- In-Production

TWS Modular Ballistic Solution (TWS MBS) **Raytheon**

Specification	TWS	LRF/DCA
Length	40 cm (15.8 in)	21.6 cm (8.5 in)
Width	16 cm (6.3 in)	8.3 cm (3.25 in)
Height	16 cm (6.3 in)	10.16 cm (4.0 in)
Weight w/ battery	2.3 kg (5.0 lb)	0.8 kg (1.8 lb)
Operating Temperature	-37° C to +49° C	-32° C to +49° C
Storage Temperature	-46° C to +71° C	-46° C to +71° C
Time to operation	Less than 120 seconds	Instantaneous
Power Requirements	6 volt BA-5847 or BB-2847	3 volt BA-5123/U or DL123A or commercial equivalent (2 ea)
Mounting	MIL-STD-1913 Rail System	MIL-STD-1913 Rail System
Remote Operation/ Data Transfer	RS-170	RS-232
Mechanical Shock	Withstands primary weapon fire shock (Mk19, M2, and other crew served weapons). Remains aligned after weapons fire.	
Range Output	First or last target ranges are displayed on the TWS within 0.2 seconds after valid return. User selectable. Selected range used for the partial ballistic solution.	
Recognize Man	2.8km	N/A
Detect Vehicle	6.9 km	N/A
Range Polarity	White hot/Black hot	N/A
Detector	40 x 16 scanning FPA, 3-5µm	N/A
Cooling	6-stage thermoelectric cooler	N/A
Detection Range	N/A	99% P(d) at >2500m, 2.3m x 2.3m 10% reflectivity target, 7km visibility
Range Accuracy	N/A	+/- 5 m (3 sigma)
First Fire	N/A	<0.10 sec. w/in receipt of command
Sustained Fire	N/A	60 pulses/minute continuous
Safety	N/A	Class I per ANSI-Z136-1-1993
False Return Rate	N/A	<1%
Wavelength	N/A	1.533 micron
Beam Divergence	N/A	86% within 0.8mr
Pulse Width	N/A	15-20 ns Full Width Half Maximum



The Thermal Weapon Sight Modular Ballistic Solution (TWS MBS) system combines a fully qualified and fielded Thermal Weapon Sight (AN/PAS-13) cabled to the Manportable Laser Rangefinder/Digital Compass Assembly (LRF/DCA) to provide a disturbed reticle for accurate engagements to the outer effective ranges of the MK19 and M2 platforms (greater than 2km). Both the TWS and LRF/DCA have been tested extensively on the MK19, M2, and other crew served weapons. The TWS MBS can be remotely operated and viewed through a common RS-170 interface port. The interface bracket for both platforms use the standard issue Army brackets with an additional rail grabber for mounting the LRF.

Weight (lb)	1.4 kg (3.0 lb) w/ battery
Detection Range	
Human	550 m
Vehicle	1650 m
Field of View	15 deg az x 11.3° el
Operating Temperature	-37° C to +49° C
Maintenance	Cleaning only
Video Output	RS-170/NTSC
Power Requirements	Commercial AA Batteries or auxiliary power (via connector for DC sources)
Mission Operation Life	5 hrs on commercial AA alkaline or lithium batteries
Detector	320 x 240 staring (76,800 pixels) FPA
Spectral Band	8-12 μm (longwave infrared)
Cooling	Uncooled ferroelectric
Weapon Compatibility	M16, M4 - Up to fully automatic 5.56mm CAL
Mounting	Picatinny MIL-1913 or NATO/STANAG



The Light Thermal Weapon Sight (LTWS) is one of the lightest thermal sights available to today's warfighter. The LTWS is based on the combat-proven technology that drives Raytheon's highly fielded line of thermal imaging products. Features of the LTWS are a 2-to-1 electronic zoom, Liquid Crystal Display (LCD), and an eyecup activated stand-by mode for power conservation. The use of the LTWS cannot be detected since it emits no light or RF energy, and it can be used round the clock as ambient light is not required for its operation. Its light weight and compact design make it ideal for use as a hand-held imager and as a rifle mounted sight.

Mission

- Allows military vehicles to operate day, night and in battlefield obscurants
- Replaces AN/VVS-2 Image Intensifier (I²)

Description

- Thermal driver's viewer which includes HTI common sensor/display and vehicle unique mounting bracket/cabling
 - Combat vehicle; replaces forward vision block in cupola
 - Tactical-wheeled vehicle; externally mounted with manual pan/tilt feature
- Long wave (8-12 μm) Infrared
- 320x240 uncooled BST FPA detector
- 30° x 40° field-of-view
 - Manual slew +/-30° & +15° FOR
- Flat panel 25 cm display (640x480 AM/LCD)
- RS-170 video output
 - Video can be distributed to other locations within the vehicle



Allows military vehicles to operate day, night and in battlefield obscurants

Customers:

- US Army and US Marine Corps
- S. Korea, Germany and Turkey

Availability

- In production

LRF/DCA Weapon Tests

- No Laser Failures
- LRF/DCA Retained Boresight



Weapon	Caliber	Total
M4 Rifle	5.56mm	21,857
M203 Grenade Launcher	40mm	588
Mk19 Grenade Machine Gun	40mm	1,001
M2 Machine Gun	.50 cal	3,400
M249 Squad Automatic Weapon (SAW)	5.56mm	2,000
M240B Machine Gun	7.62mm	2,000
		<hr/> 30,846

OCSW Weapon System

- ✓ Weapon/FCS Integration
- ✓ Boresight Retention
- ✓ Weapon Firing Shock Loads



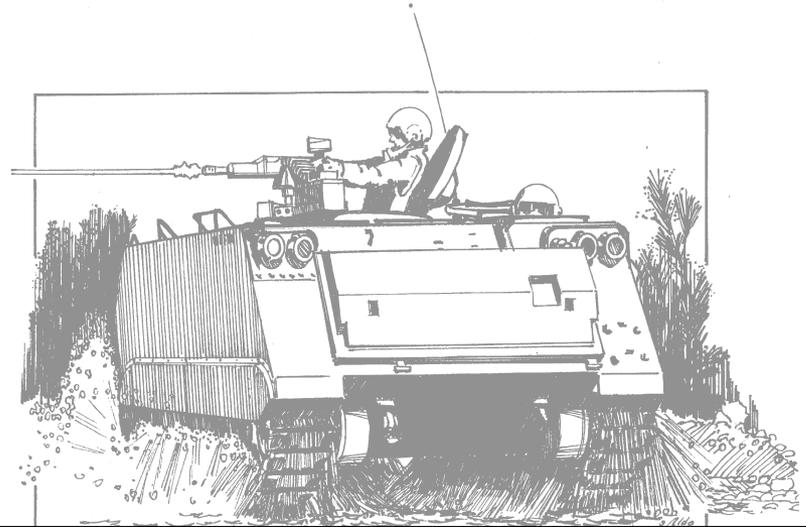


Full Solution Fire Control

- 2.2 km Range Performance
- $< \pm 1$ meter Laser Rangefinder
- Ballistic Processor
- Single Reticle
- Fuze Setter
- Digital Compass
- Embedded Training
- MILES/CIDDS
- Thermal Interface
- Direct View Optics 5x9.5° FOV
- Land Warrior Ready
- Laser Steering
- Motion Tracker
- Moving Targets

Stationary weapon engaging a moving target.

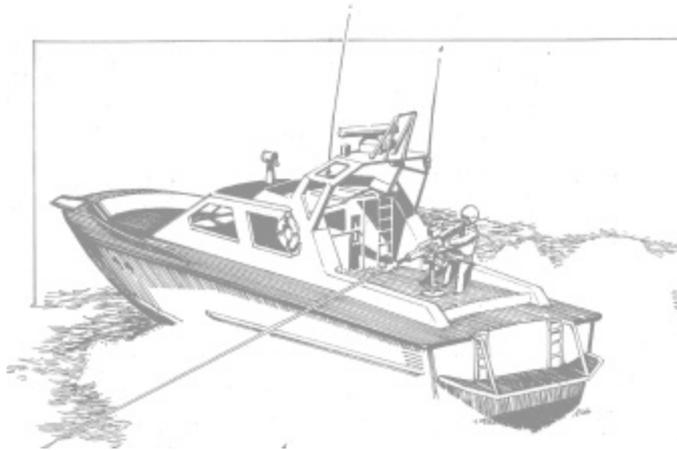
- Objective: Soldier places reticle on target & fires weapon.
- OCSW Approach:
 - x & y angular speed is measured via tracker & thermal sensor.
 - z speed (range rate) is determined via laser range finder.
 - 3-D (x,y,z) target vector input to ballistic computation yields ballistically adjusted reticle with lead angle for target motion compensation, any range to intercept for fuze setting.



The OCSW Full Solution Fire Control Sensor Suite is ideally suited to effectively engage lightly armored moving targets.

Moving weapon engaging a moving target.

- Objective: Engage moving targets from a moving vehicle.
- OCSW Approach:
 - Tracker, Laser & Thermal sensors determine relative 3-D target vector.
 - Ballistic computation yields aim point compensated for relative motion.
 - Weapon is aimed via 2-axis stabilized gimbaled platform.
 - Weapon is remotely fired by crew.



The OCSW has Potential for Multiple Platform Applications as Primary/Secondary Armament.

- **Maximize Component Commonality with Other Products (laser, thermal, compass, camera, electronics, etc...)**
 - Common module architecture
 - Minimize development cost
 - Minimize O&S cost
 - Reduce TA/FCS unit cost via larger production quantities

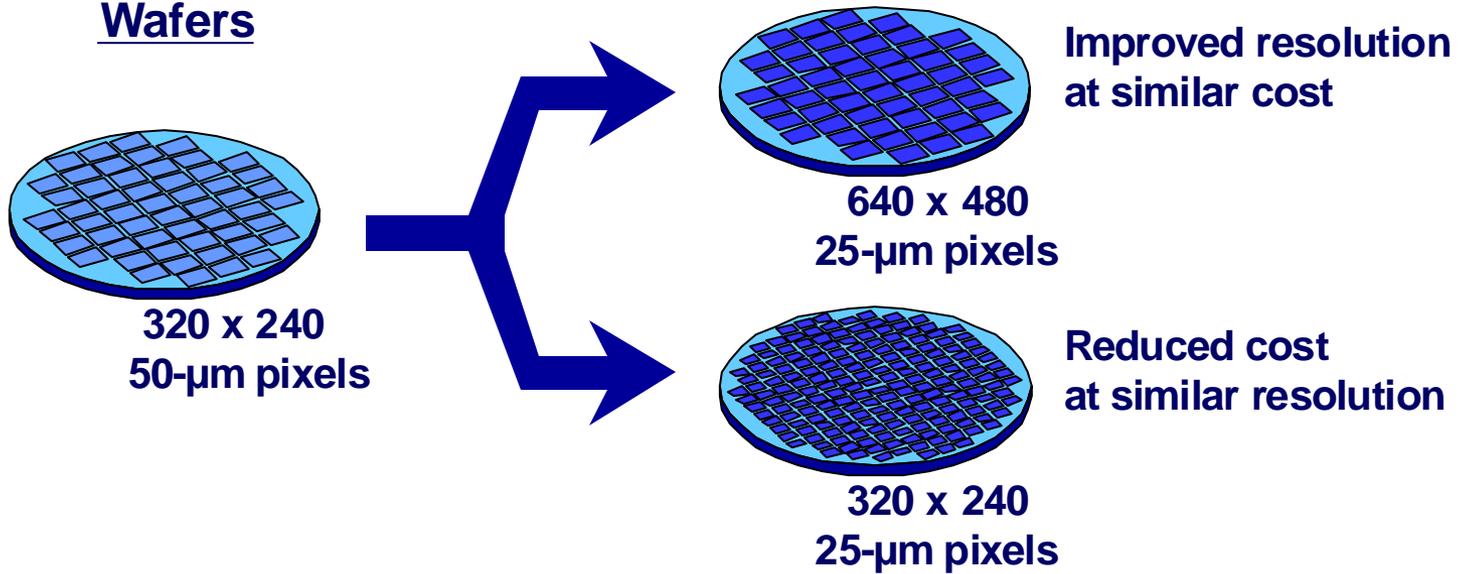
- **Leverage Raytheon's Many Diverse Technologies and Programs**
 - Increased performance at less cost, weight and risk

- **All Solid State Design**
 - Leap-ahead in reliability and maintainability
 - Low power and weight

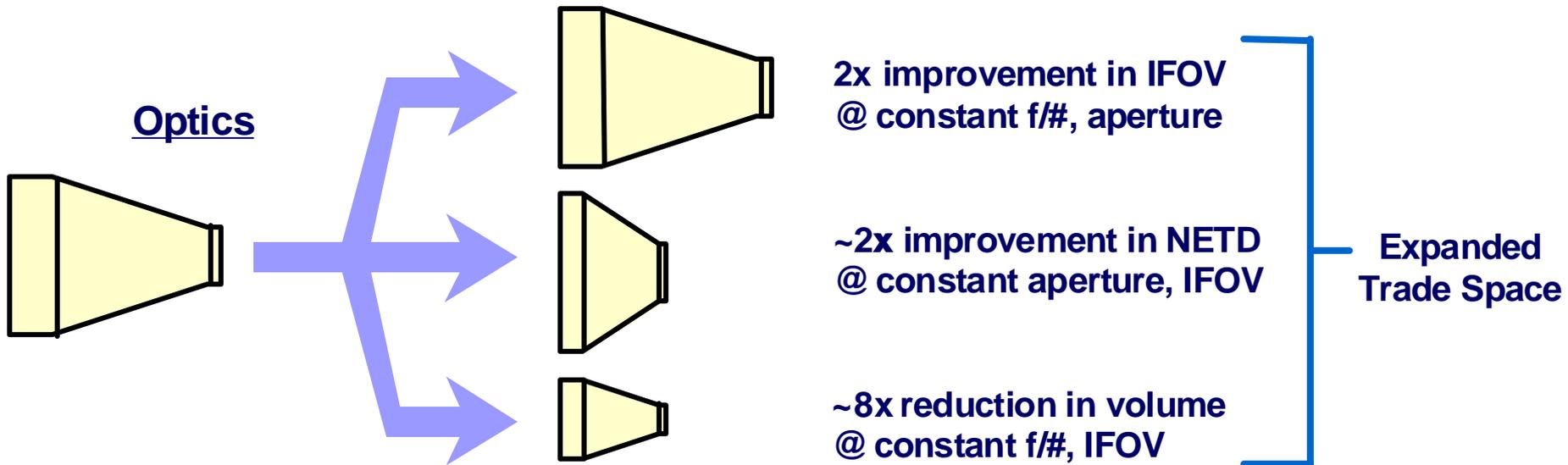
- **25 Micron Uncooled Thermal Detector**
 - 8x reduction in volume compared with 50 Micron for constant F/# and IFOV
- **Ability to Integrate Electronics**
- **Laser**
 - Diffraction limited beam minimizes optics weight/cost
 - Single pump diode and passive Q-switch
 - Very efficient low cost/weight cavity
- **Low Cost/High Sensitivity Laser Detector**
 - Minimizes required transmitted energy
 - Ruggedized low cost production detector hybrid
- **Solid State Laser Steering**
 - Very low cost: No mechanical moving parts
- **Advanced Materials/Composites**

Smaller Pixel Yields Dramatic System Improvements

Wafers



Optics



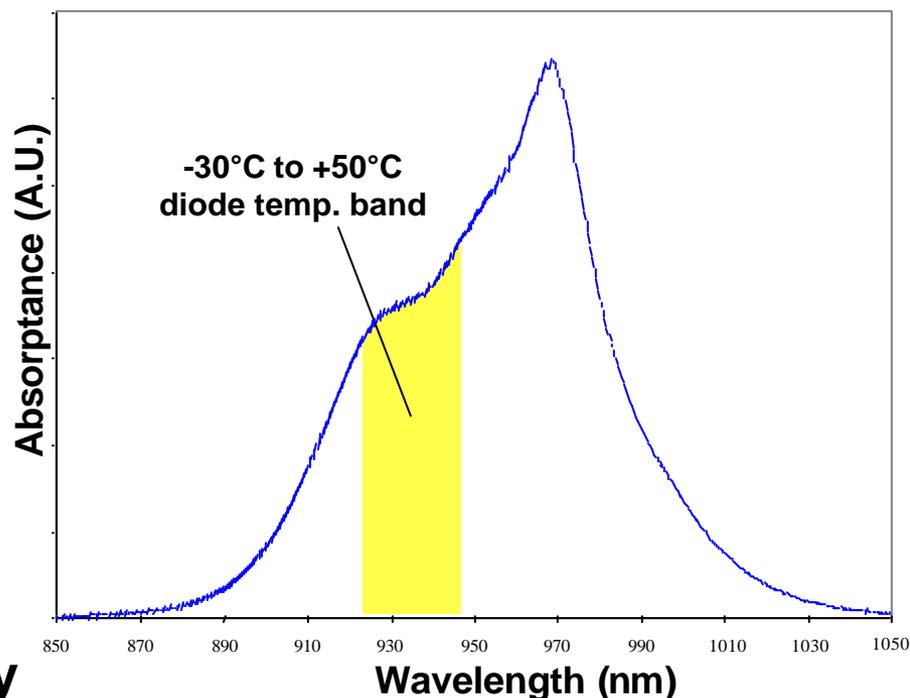
Passive - Cooling Diffraction Limited Beam - 100% Solid State

Key advantages of diode-pumped Er:Yb:glass:

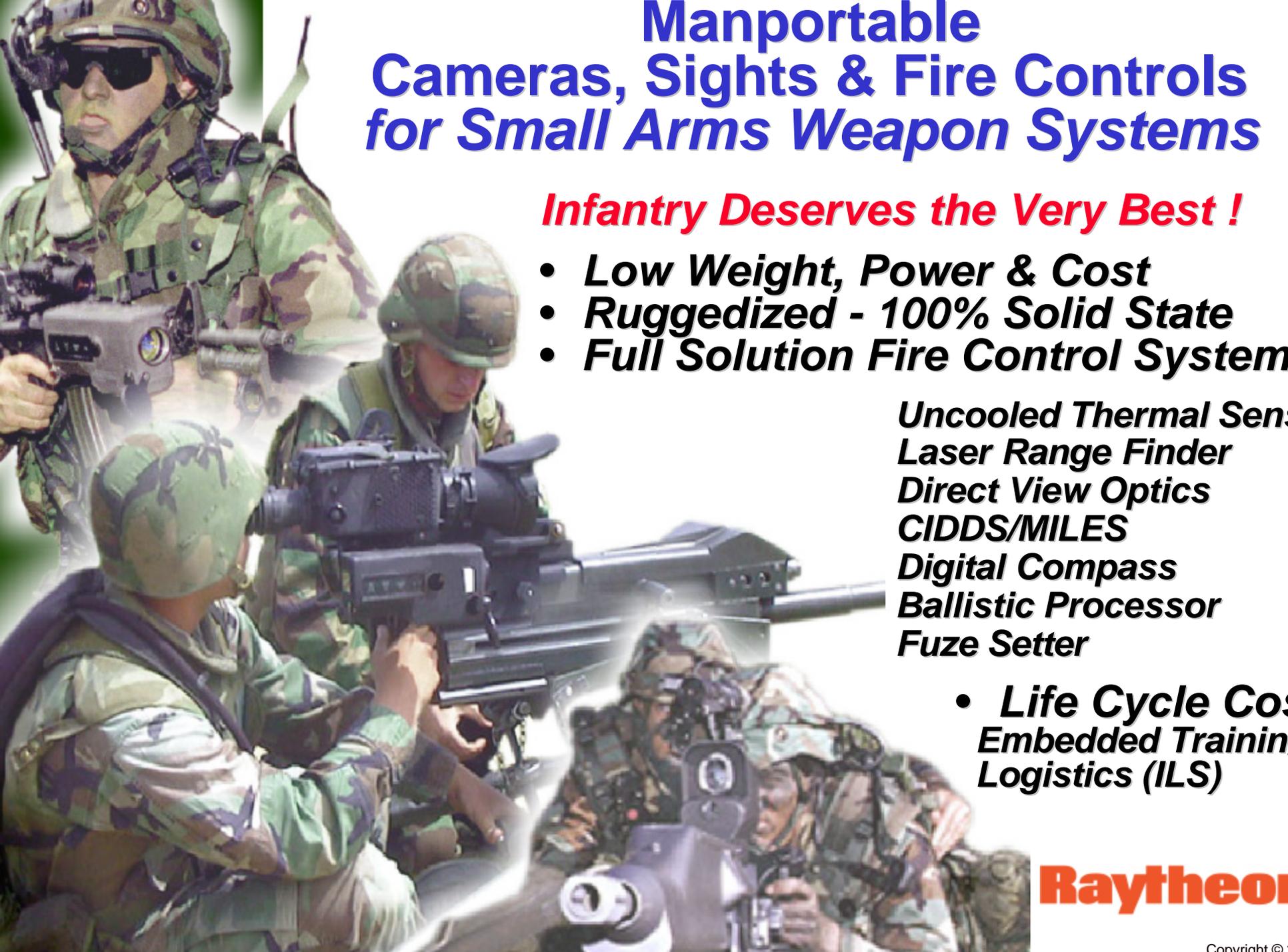
- ✓ **Direct eyesafe wavelength**
 - no wavelength conversion
 - fewer components
 - diffraction limited beam quality
- ✓ **Broad Yb absorption**
 - insensitive to diode wavelength shifts over temperature
 - passive cooling

Enabling technologies:

- ✓ **Passive Q-switch**
- ✓ **High efficiency diode pump cavity**
- ✓ **Long Er lifetime (> 30x that of Nd:YAG)**
 - more pump energy per diode bar



Leap-Ahead Cost Advantage



Manportable Cameras, Sights & Fire Controls for Small Arms Weapon Systems

Infantry Deserves the Very Best !

- ***Low Weight, Power & Cost***
- ***Ruggedized - 100% Solid State***
- ***Full Solution Fire Control System***

***Uncooled Thermal Sensor
Laser Range Finder
Direct View Optics
CIDDS/MILES
Digital Compass
Ballistic Processor
Fuze Setter***

- ***Life Cycle Cost
Embedded Training
Logistics (ILS)***

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Small Arms

Fire Control Systems & Thermal Sights

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