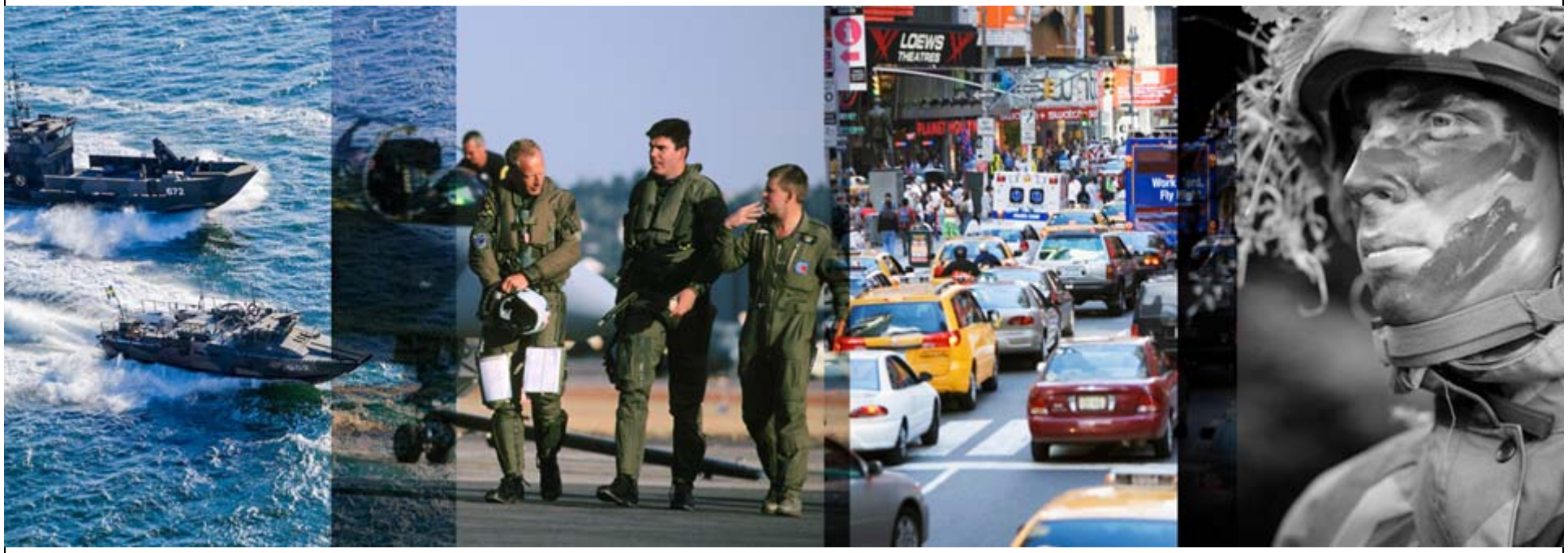
Next Generation Laser Warning



November 12, 2008

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LASER THREATS

- **Laser Range Finder**
  - ≈ Single Pulse to 8 Hz PRF
  - ≈ High Power, Small Divergence
  - ≈ Use Laser Pulse Time of Flight and Reflectance to operate
  - ≈ Wavelengths (1.064 um, 1.54 um, 10.64 um)
  - ≈ Wavelengths (904 nm, 1.54 um)

- **Laser Target Designator**
  - ≈ 8Hz to 40 Hz PRF
  - ≈ Even Higher Power, Smaller Divergence
  - ≈ Warning time 5-20 sec (Laser on for terminal guidance)
  - ≈ Pulse-Trains makes simultaneous engagement of multiple targets possible
  - ≈ Wavelengths (1.064 um)

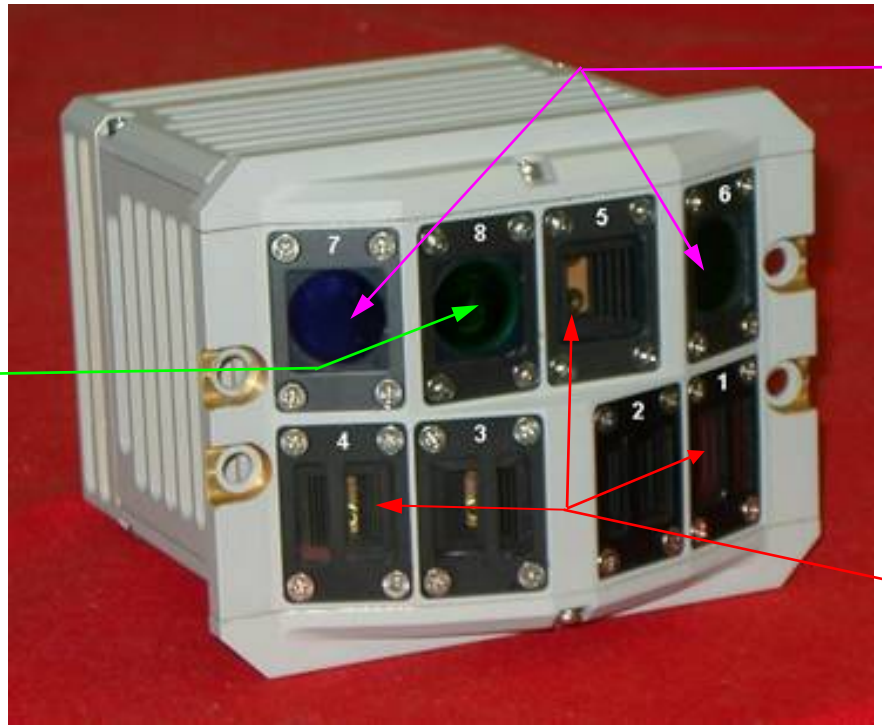
LASER THREATS

- **Laser Beam Riding Missiles**
  - ≈ Difficult to detect and jam
  - ≈ kHz PRF
  - ≈ Wavelengths (904 nm, 1.064 um)
  - ≈ Wavelengths (10.64 um)
- **Laser Weapons/Blinders**
  - ≈ Threat to human eye
  - ≈ Threat to EO systems
  - ≈ Wavelengths (0.532 um)
- **LIDAR**
  - ≈ Naval - Submarines
  - ≈ Wavelengths (0.47 - 0.532) um

LWS Design Parameters

- Wavelength Coverage
- AOA Accuracy
- Sensitivity
- FOV
- POW
- FAR
- Platform Coverage
- Threat Classification and Identification
- Environmental Considerations
- Cost

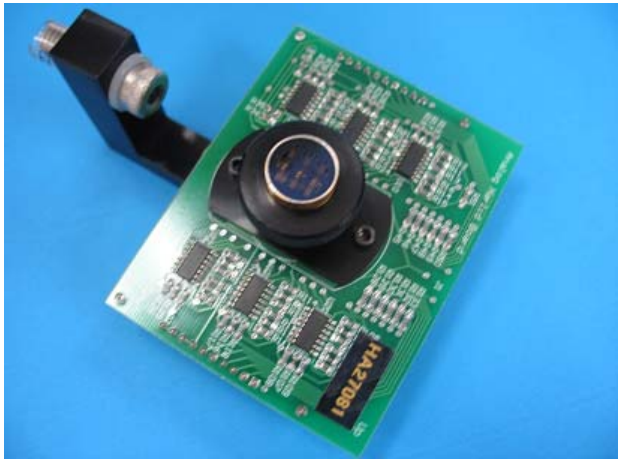
Current Laser Warning Systems



→	InGaAs (1,2,3,4,5)	(0.85 - 1.7) μm
→	Silicon (6,7)	(0.75 – 1.064) μm
→	Silicon (8)	(0.532 μm)

Current Laser Warning Systems

Specification	Range
AOA Accuracy (RMS)	
LRF & LTD	1.0º to 15º
LBR	22.5º to 45º
Others	15º to 45º
Sensitivity (W/m^2)	
LRF & LTD	20
LBR	0.1 to 0.5
Others	20 to 150
Field of View	
Azimuth	>90º
Elevation	80º

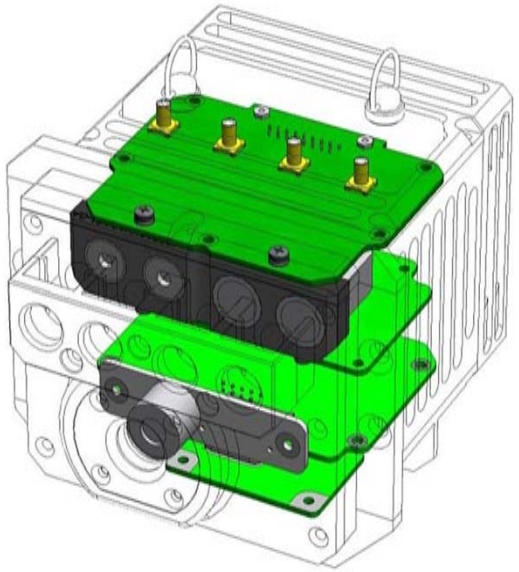


Next Generation Laser Threats

- **Performance Optimization**
- **Wider use of available Laser Wavelengths**
- **Lower Power**
- **Increased Operating Distances**
- **Smarter Threats**

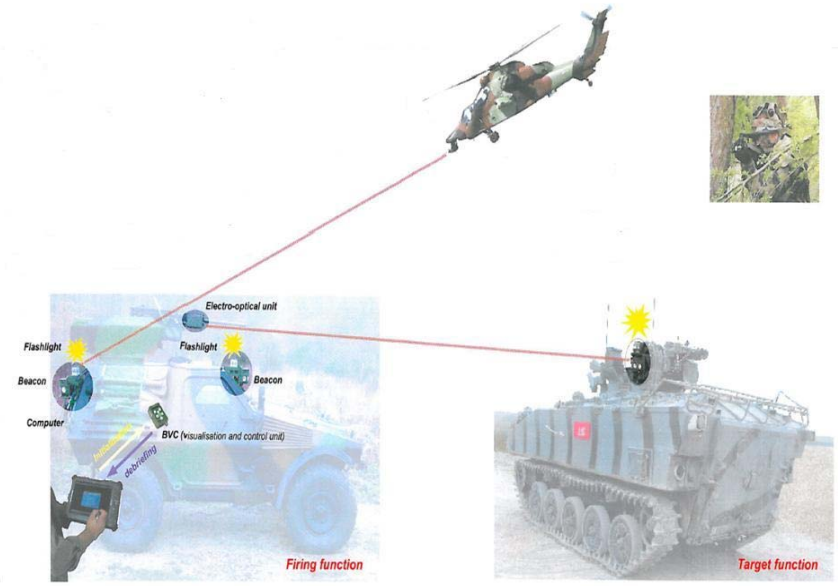
Next Generation Laser Detection

- **Requirements critical for a future competitive Laser Warning System**
  - **Improving the Beam rider Sensitivity from the current performance to (< 0.01 W/m² @ 904 nm)**
  - **Expanding Rangefinder detection to include Low Powe-- Rangefinders @ 904 nm and 1.54 um**
  - **Angle of Arrival Accuracy of typically 1° RMS needed**
  - **Option to detect CO_2 lasers @ 10.64 um**
  - **Optical False alarm suppression**



Next Generation Laser Detection Continued

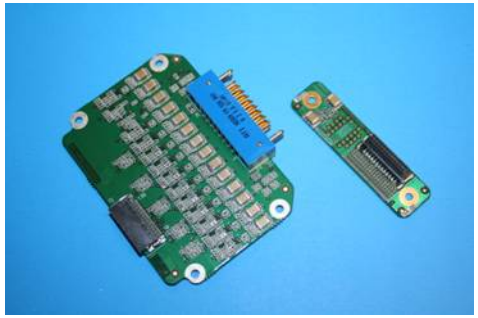
- Extend Platform Coverage for large Platforms; Current System Maximum 6 Sensors
  - Extend to 8 Sensors, 12 Sensors, 16 Sensors
- Laser Training Capability
- Smarter detection i.e. Classification and Identification
  - Handling staggered PRI Threats
  - Filtering of Harmonics
- On-board Testability and Maintenance
- Ease of integration onto platforms
- LWSS must be modular
- Cost



Saab Avitronics has done Research on most of these elements and now have the capability to implement new technologies and techniques in LWSS to meet these requirements.

Advantages of this Approach

- Modular and Scalable Design
  - The client need and budget will determine the configuration of the sensor without changing the basic design
  - Possibility of cost effective product improvement as technologies and threats change
- AOA Accuracy (LRF/LTD) of 1º RMS typically will be a client option
- Improved LBR Sensitivity and detection of Low Power Rangefinders
- CO_2 detection will be a client option
- Optical False Alarm Rejection will improve sensor FAR
- Upgrading sensor firmware using the operational ports is possible
- Sensor can be used together with Laser Training simulators
- Sensor stimulator will be integrated into the sensor itself for BIT



The Next Generation Laser Warning System: A Software Perspective

- ***De-interleaving and Pulse Processing:***
  - **Advanced pulse train techniques.**
  - **Capability to process new threat signatures.**

- ***Laser Training Systems:***
  - **High level of interoperability with Laser Training Systems for at least market leading LTS system**
  - **This capability may not deteriorate the laser warning capability.**

- ***Battle Management:***
  - **Integration to various Battle Management Systems**
  - **Using information from the Battle Managements system or its own**
  - **INS information utilized**

- **Part of total solution and not just stand-alone**

Future Detection Systems

- Optical Fiber Sensor Head
  - Electro-Magnetic Interference advantage
- Temporal Coherence Detection - Michelson Interferometer as a Fourier Transform device
- Advanced Detection Sensitivity

[1] X1. Zhang Jilong, Wang Zhi-bin, Li Xiao, Tian Eerming. A Review of Laser warning Receiver Based on Spectral Discrimination and Coherent Detection, *Journal of Test and Measurement Technology*, Vol. 20, No. 2, 2006, pp. 95-101. 2

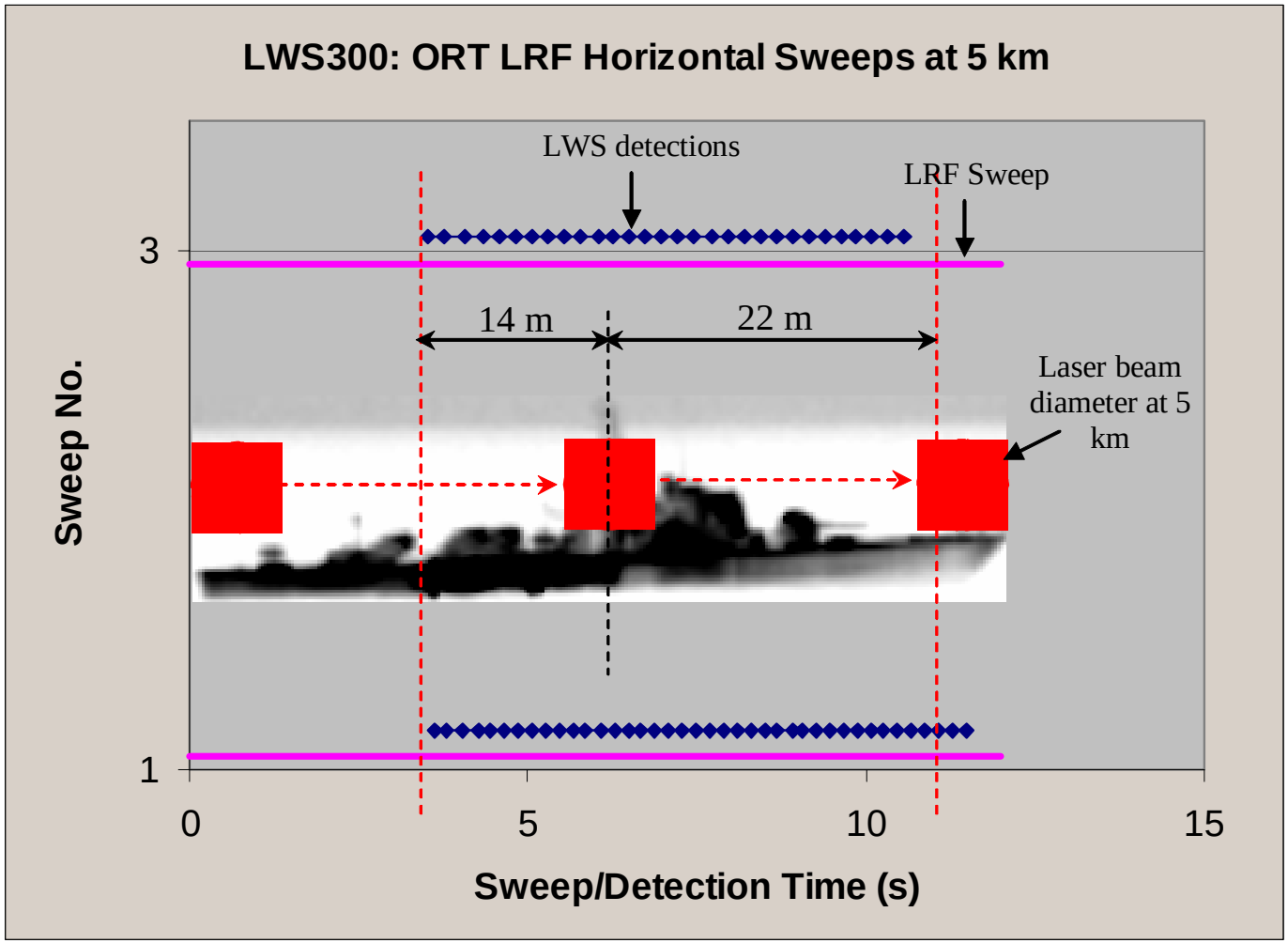
- Two dimensional AOA detection
  - Four sensors with Optics Covering > 90 deg
  - Special developed imagining and processing device

Summary

- Part of total solution
- Address the requirements in a flexible and cost effective way

END

Platform Coverage



Imaging LWS