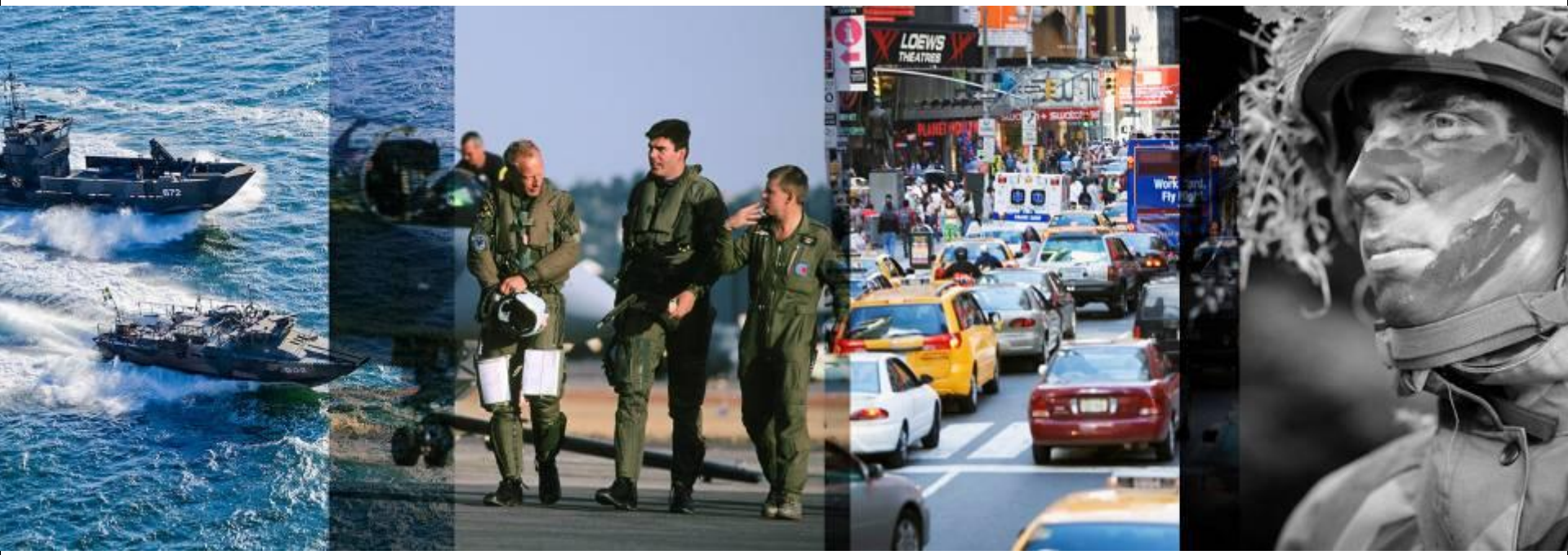
Mission Configurable Self Protection Solutions



Christer Zätterqvist
September 14 2011
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The problem in a nutshell

- Plethora of threat types
- Threat type Center of Gravity changes with phase of conflict
- Limited platform flexibility to effortlessly receive new capabilities
- Current airborne EW systems does not address all relevant threats
- Industry (and user) tend to dig in the same ditch

The million $ question is: *What do we do about it?*

Survivability

- The mission
  - Increased Aircraft Combat Survivability (P_S)
    - Susceptibility to threats (P_H)
    - Threat vulnerability ($P_K|_H$)
    - Maximizing $P_S = 1 - P_H P_K|_H$ (1- Susceptibility * Vulnerability)
  - Increased combat effectiveness
  - Achieve as many successful landings as take-offs…

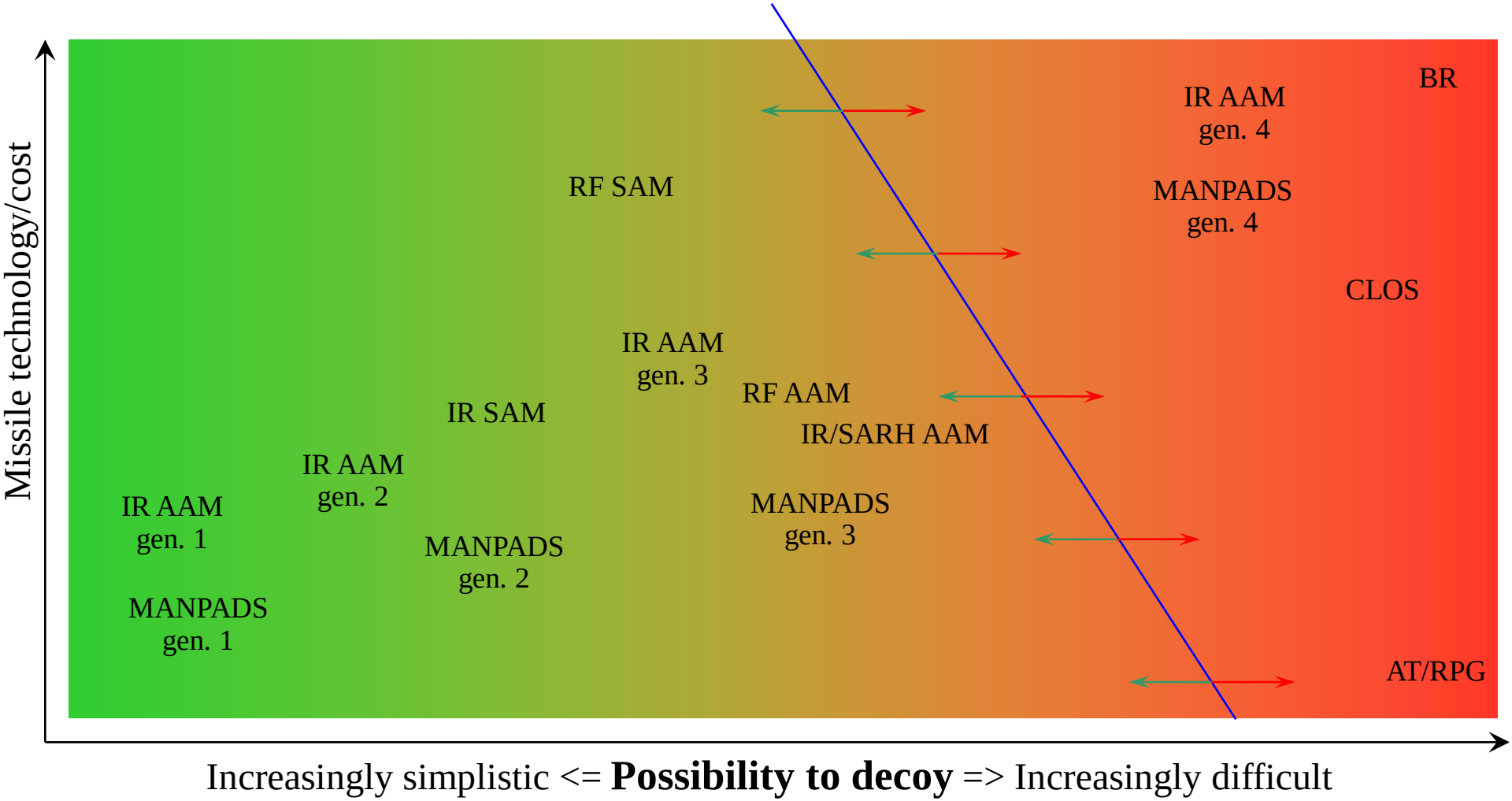
Survivability enhancement factors

- Preventive / Tactical
  - Arms control
  - Port and border security
- Tactics
  - Flying tactics and operating procedures
  - Speed / altitude
  - Situational awareness
  - ConOps
- Technical
  - Hardening of structure
  - Ruggedized airframe
  - Blast protection
  - Signature reduction
  - System redundancy
  - Countermeasures

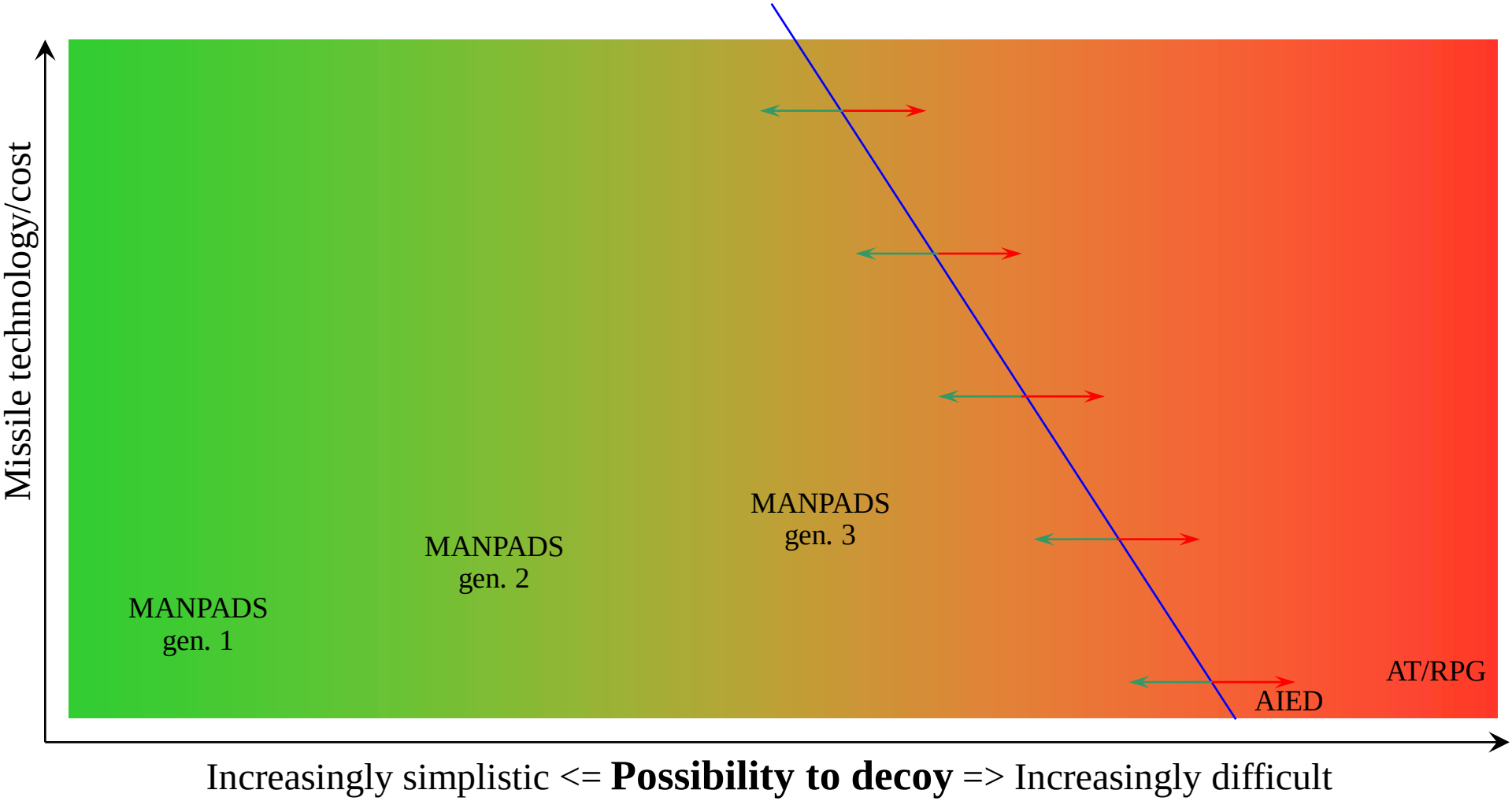
Type of threats

- Small arms
- MANPADS (SA-7, SA-14, SA-16, SA-18, HN-5, FN-6)
- IR AAM (AA-8, AA-11)
- IR SAM (SA-9, SA-13)
- RF AAM (AA-9, AA-12)
- RF SAM (Command type, SA-2, SA-3, SA-4, SA-5, SA-6, SA-8, SA-10, SA-15)
- IR/RF AAM (also IR/SARH Semi Active Radar Homing, AA-2, AA-6, AA-7, AA-10)
- CLOS (LLTV, Wire, Radar, Radio)
- Beam riders
- AT/RPG (RPG-7)
- AIED

Outset of conflict

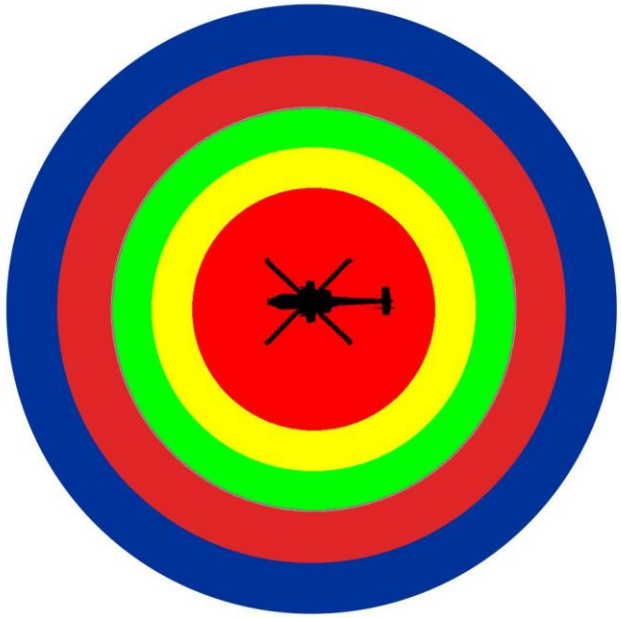


A bit into (recent) conflicts



The desired EW toolbox

- Missile warning
- Laser warning
- Radar warning
- Hostile fire indication
- Reactive dispensing (chaff and flare)
- Pre-emptive dispensing (chaff and flare)
- Post-emptive dispensing (chaff and flare)
- RF jamming
- Directed energy system
- Hardkill system



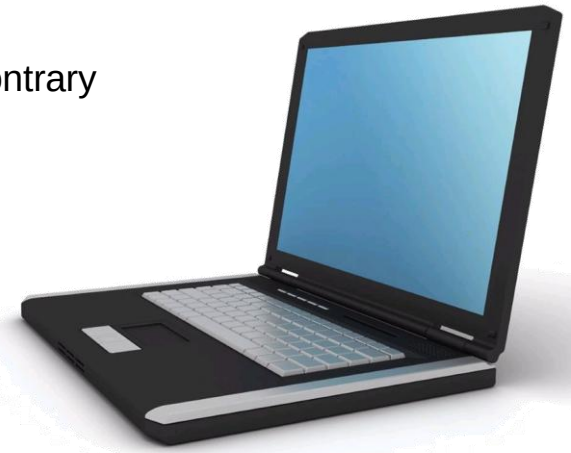
Layers of protection

How do I get my fantastic gizmo installed on the Aircraft?

A few pieces of the puzzle

- Interfaces
  - Mechanical
  - Control
  - Power
  - HMI
- Incompatibility drives cost and schedule

Commercial example to the contrary



Addressing the issues

Example of Initiatives

- BOL
- BOH
- TIPS

BOL in missile launcher

Prototype BOH-300

BOL

- Operational in several Air Forces
- Electromechanical dispensing
- Installable into;
  - Launcher
  - Conformal housing
  - Pylon
  - Vacant external store volume
- Reactive dispensing
- Pre-emptive dispensing
- Post-emptive dispensing
- Combat proven
- > 2000 BOL Dispensers delivered, still counting..

BOL track record

Tornado

Saab 2000 AEW&C

Gripen

F-15 Eagle

F-18 Hornet

EF-2000 Typhoon

Retired platforms

F-14 Tomcat

Viggen

Harrier

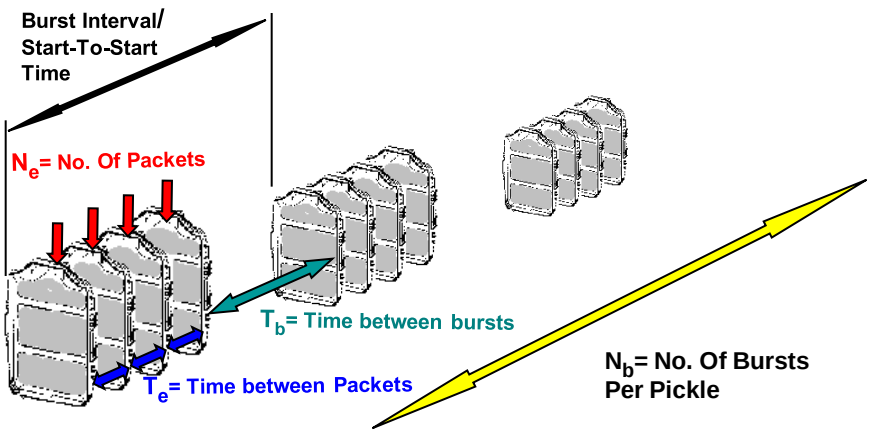
Addressing the cost / schedule issues
BOL

- Interfaces
  - Mechanical
  - Control
  - Power
  - HMI

- Installable into;
  - Launcher
  - Conformal housing
  - Pylon
  - Vacant external store volume
- Control means
  - Discrete signals
  - MIL-STD-1553
  - RS-485
  - (wireless if needed..)
- Power
  - 115VAC / 400 Hz
  - 28 VDC in the works
- HMI
  - External BIT indication
  - Dovetail into existing CMDS architecture

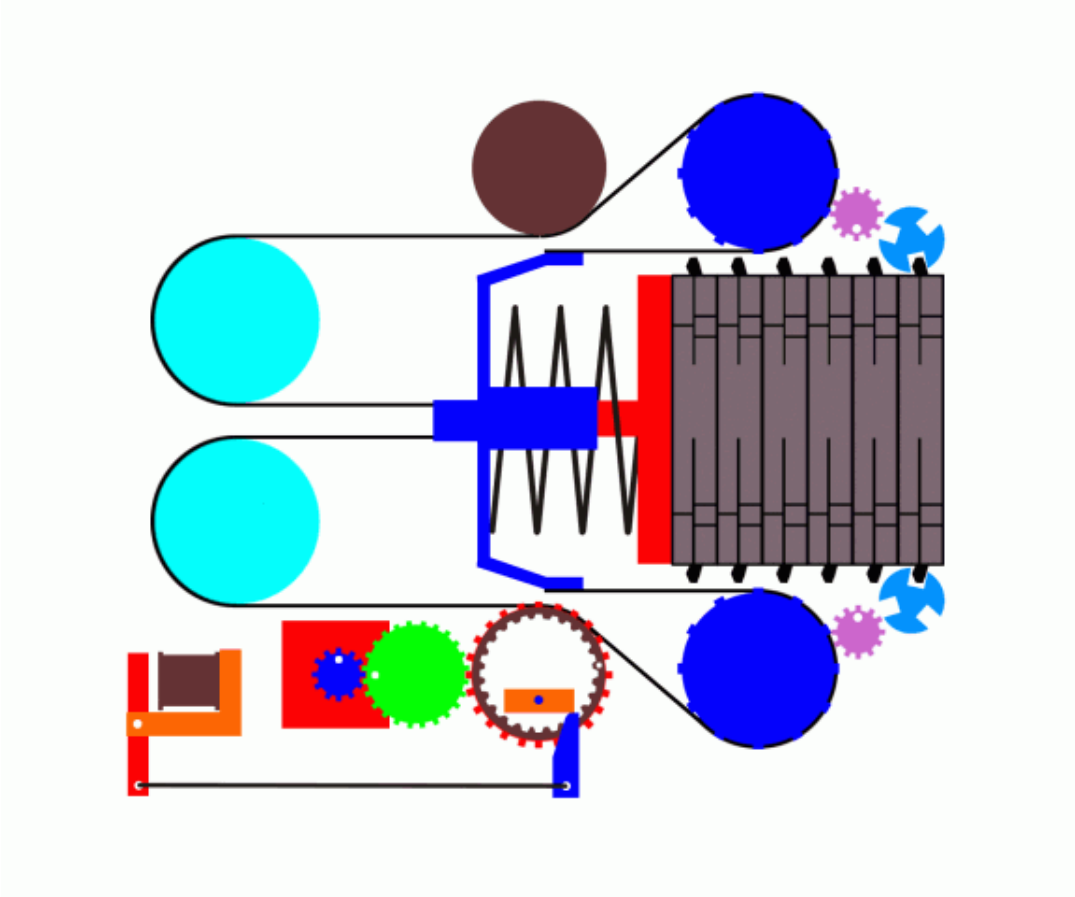
BOL Dispensing

Typical pre-emptive sequence for twin-engine A/C



Example:
Ne = 4
Te = xx ms
Nb = 3
Tb = xx ms

BOL mechanism



Theory of operation

BOL decoys

BOL Chaff Packs

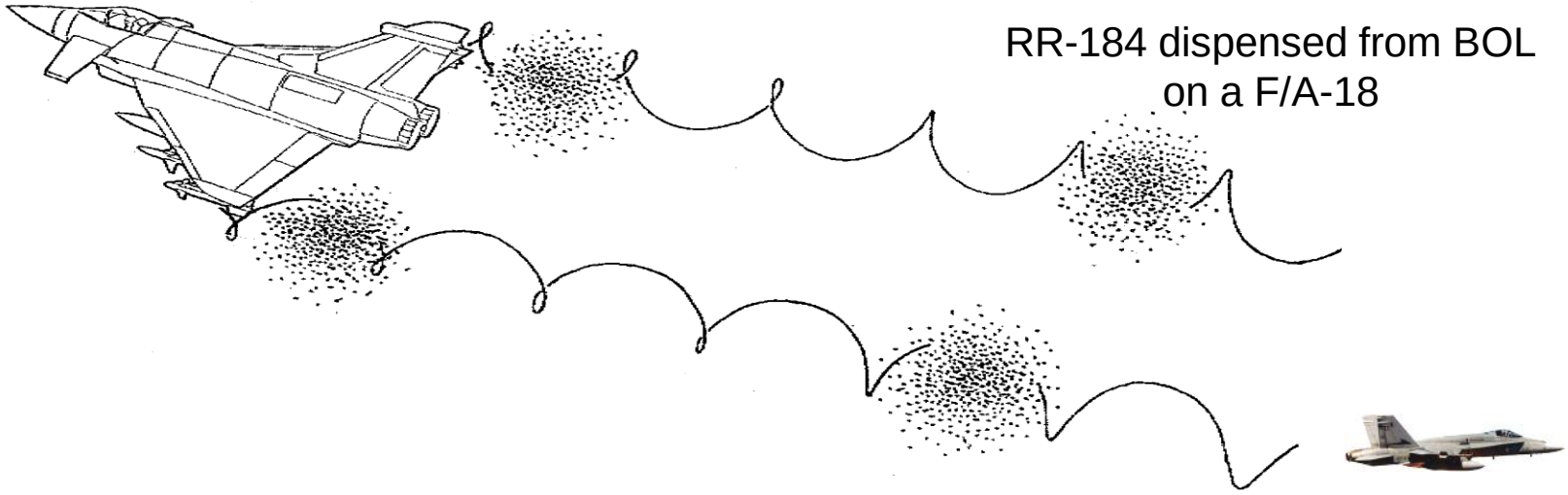
BOL IR Packs

BOL chaff

- Characteristics
  - Electromechanically dispensed
  - Individually packed
  - Affordable
  - Safe to handle
  - Superior effectiveness
  - >10 m^2 RCS all frequencies
  - >10 m^2 doppler content
  - Frequency coverage 2-18 GHz

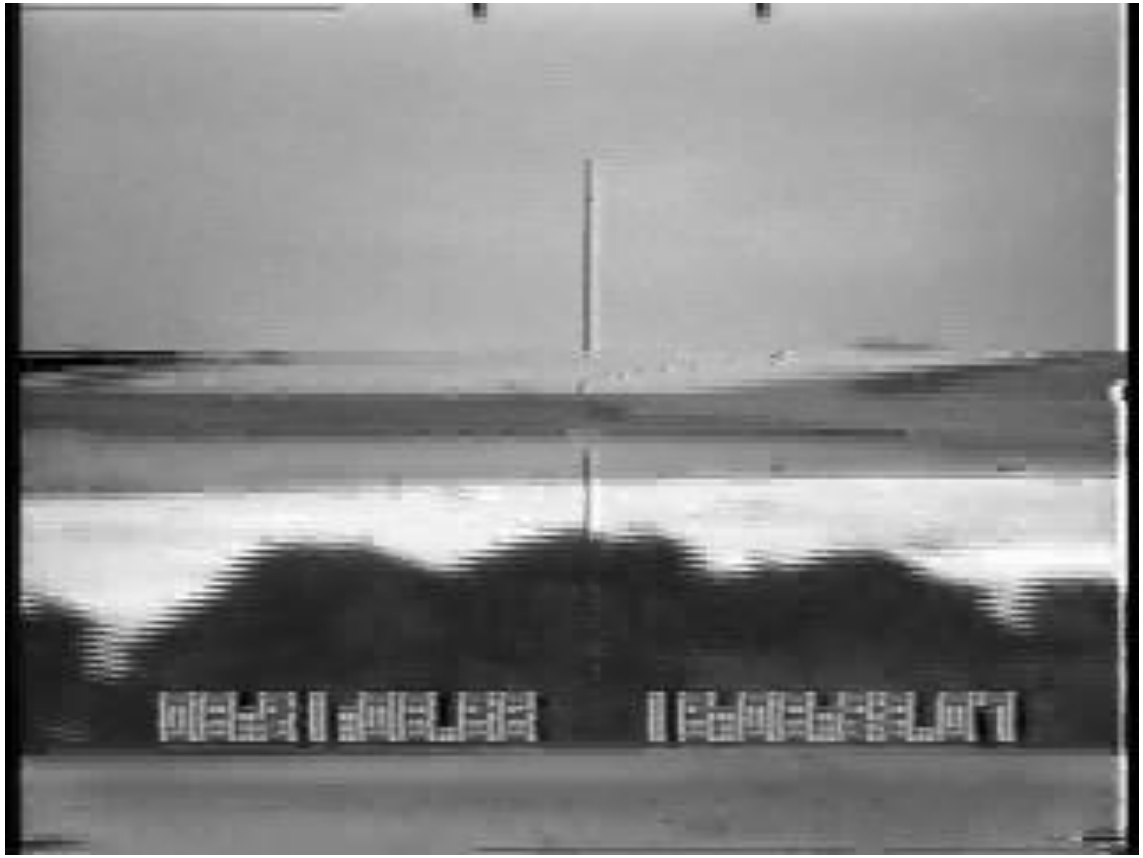
BOL chaff

- Chaff dispensed from the wings use the vortices to enhance RCS build and to generate Doppler contents



RR-184 dispensed from BOL on a F/A-18

BOL chaff

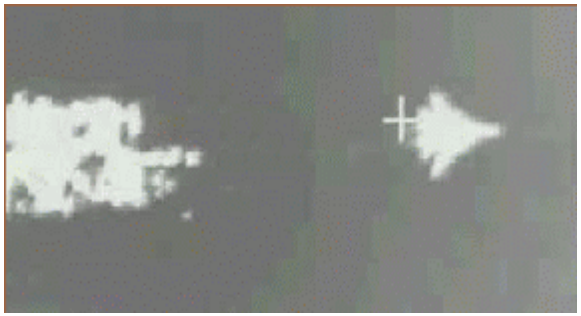


BOL IR

- Characteristics
  - Electromechanically dispensed
  - Pyrophoric
  - Covert, almost
  - NVG compatible
  - Individually packed
  - Mechanically dispensed
  - Safe to handle
  - Superior effectiveness

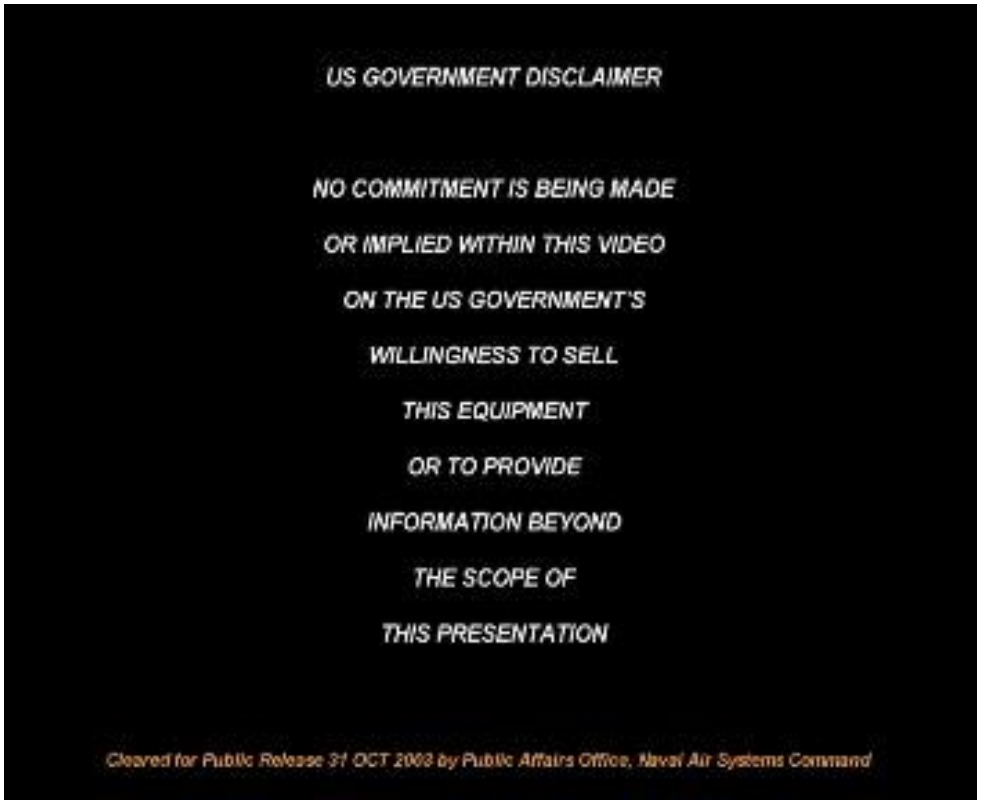
BOL IR

- IR
  - Pre-emptive
    - Effective for both ground based (MANPADS) and airborne (AA) threats
    - Avoid missile acquisition (Acquisition denial)
    - Missile tracks IR energy in decoy, decoy cools → missile reattempt to acquire



Pre-emptive dispensing

BOL IR
Dispense from F-14



BOL IR
Dispense from S-3

BOH, the idea

- In the leanest possible way provide additional advanced countermeasures capability
- Use the same electrical and hardware interfaces common missiles
- Facilitate carriage on missile launchers
- Adapter to allow mounting using 14” or 30” NATO lugs
- Incorporate mature technologies
  - BOL electromechanical dispenser
  - Forward firing (pyrotechnical) dispenser
  - Missile Approach Warning
- Reuse existing technology, products, modules and building blocks to minimizing development cost/lead-time and risks

On a mission-to-mission basis, BOH is a “missile-replacement” providing EW capability

System building blocks

- BOL (electromechanical RF and IR dispenser)
- IDAS (Integrated Defensive Aids Suite)
  - EWC (controller)
  - MAW (Missile Approach Warner)
  - LWS (Laser Warner Sensor)
  - BOP (Pyrotechnical dispenser)
  - SPU (Safety Pin Unit)

BOL

EWC

MAW

LWS

BOP

SPU

IDAS

Main BOH configurations and layout

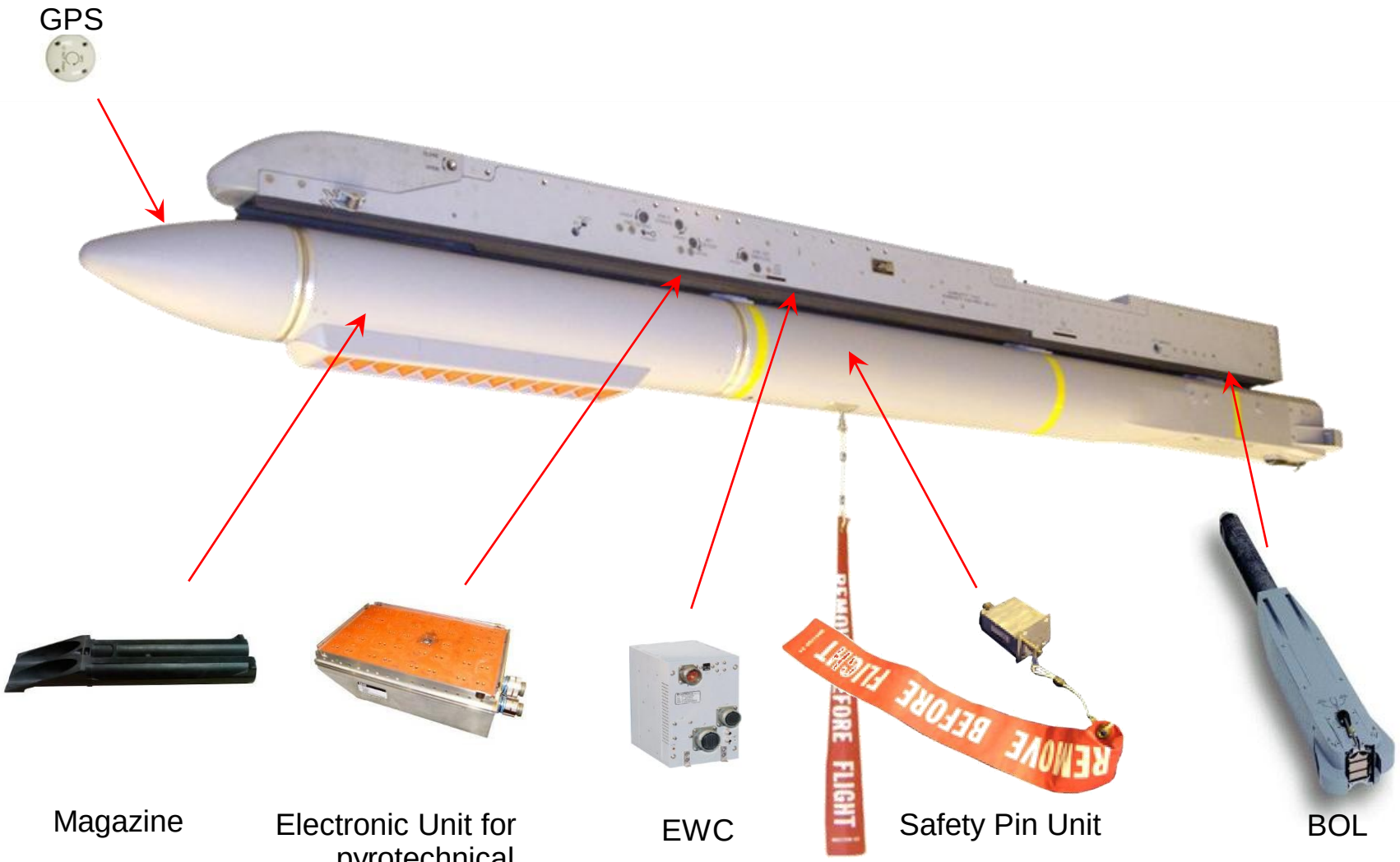
Prototype BOH-200

Config#	Nose	Front module	Center module	Aft module
BOH-100	Fairing*	-	SPU, EWC	BOL
BOH-200	Fairing*	BOP	SPU, EWC	BOL
BOH-300	MAW*	BOP	SPU, EWC	BOL

* GPS optional

Prototype BOH-300

BOH-200 building blocks



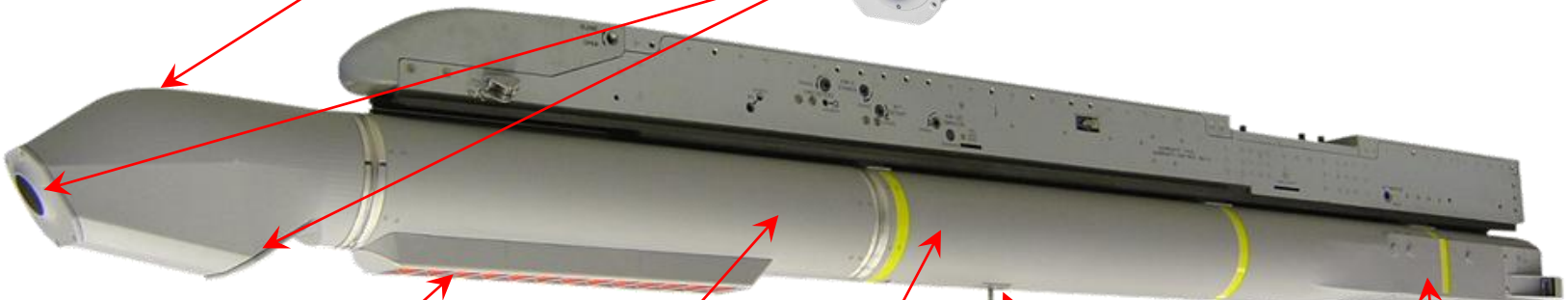
BOH-300 building blocks

LWS

Alternative sensor

GPS

MAW



Magazine

Electronic Unit for pyrotechnical dispenser

EWC

Safety Pin Unit

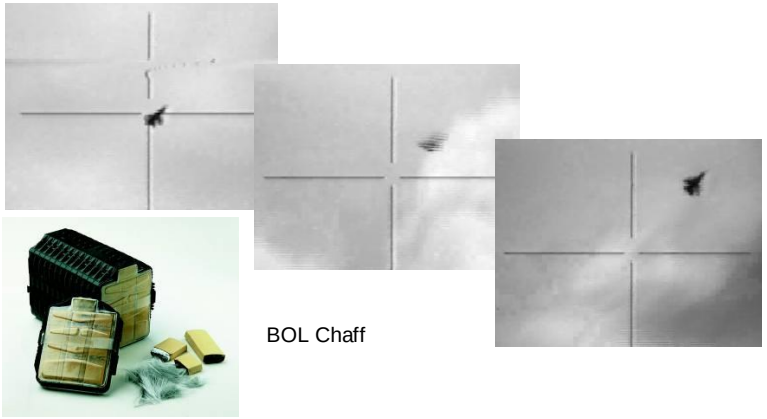
BOL

Addressing the cost / schedule issues
BOH

- Interfaces
  - Mechanical
  - Control
  - Power
  - HMI

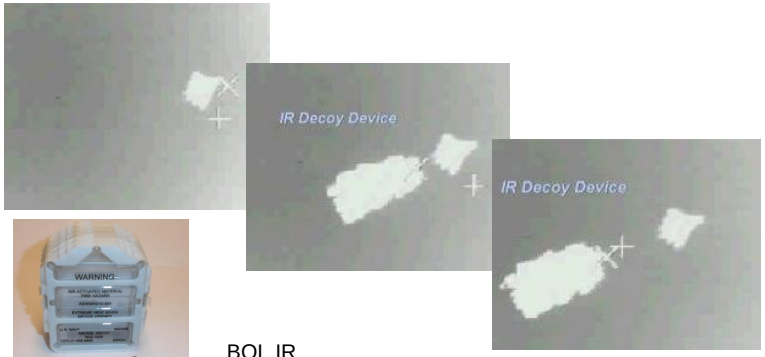
- Installable any missile launcher;
  - LAU-7, LAU-120 series, MML etc. etc.
- Control means
  - Autonomous (if mode selected)
  - Discrete signals
  - MIL-STD-1553 (weapons MUX Bus)
  - RS-485
  - (wireless if needed..)
- Power
  - 115VAC and 28 VDC (missile power)
  - RAT coming
- HMI
  - External BIT indication
  - Dovetail into existing CMDS architecture
  - Integration via SW

BOH decoys

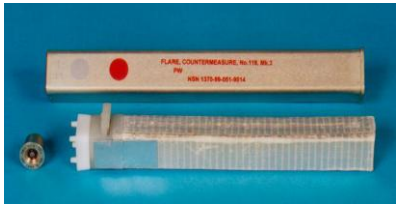


BOL Chaff

No. 218 K7 Type 1 propelled flare



BOL IR



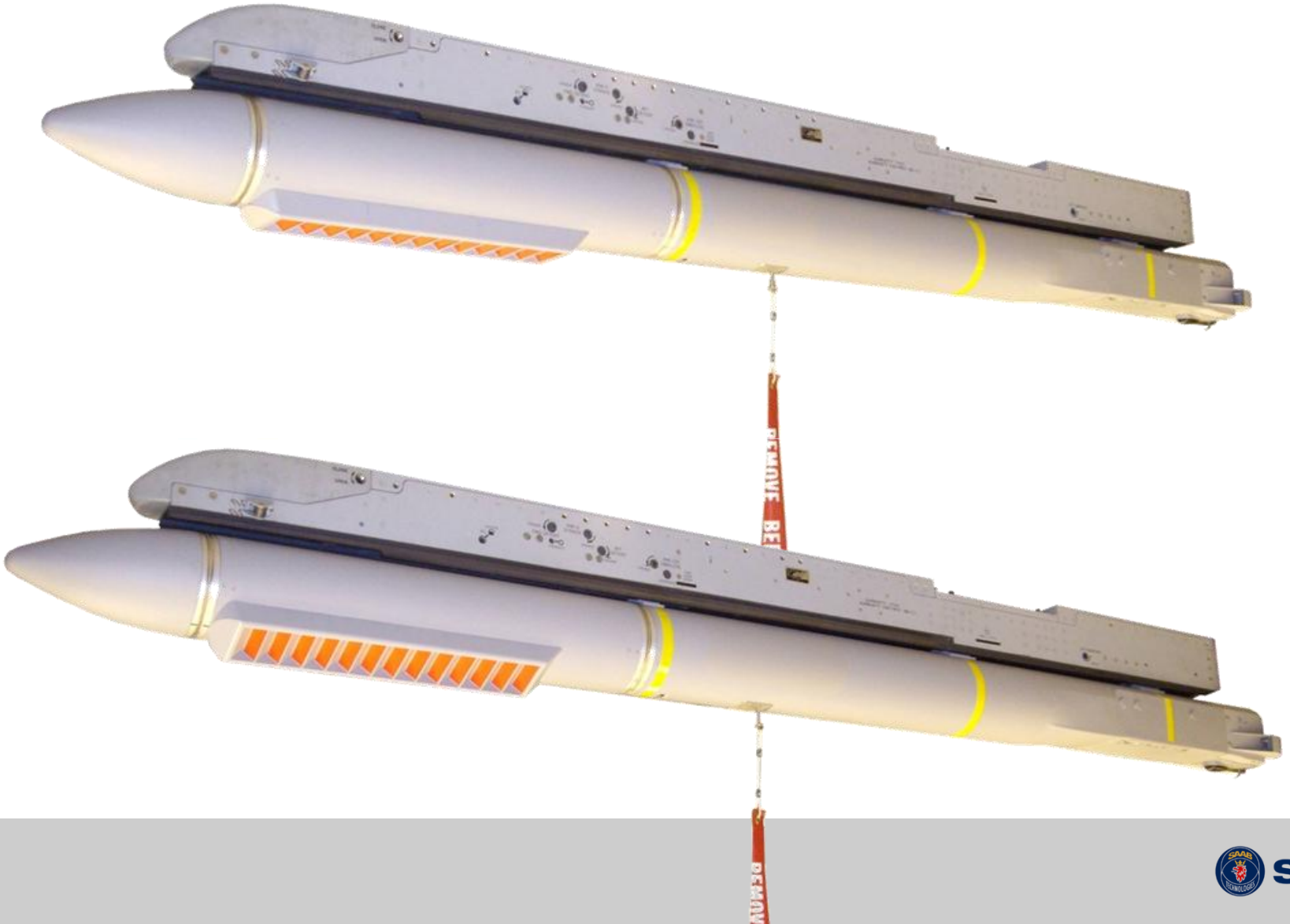
Standard 118 size

Standard 218 size

BOZ EC trials

BOZ EC trials

BOH on USAF LAU-129 Launcher (for F-16)



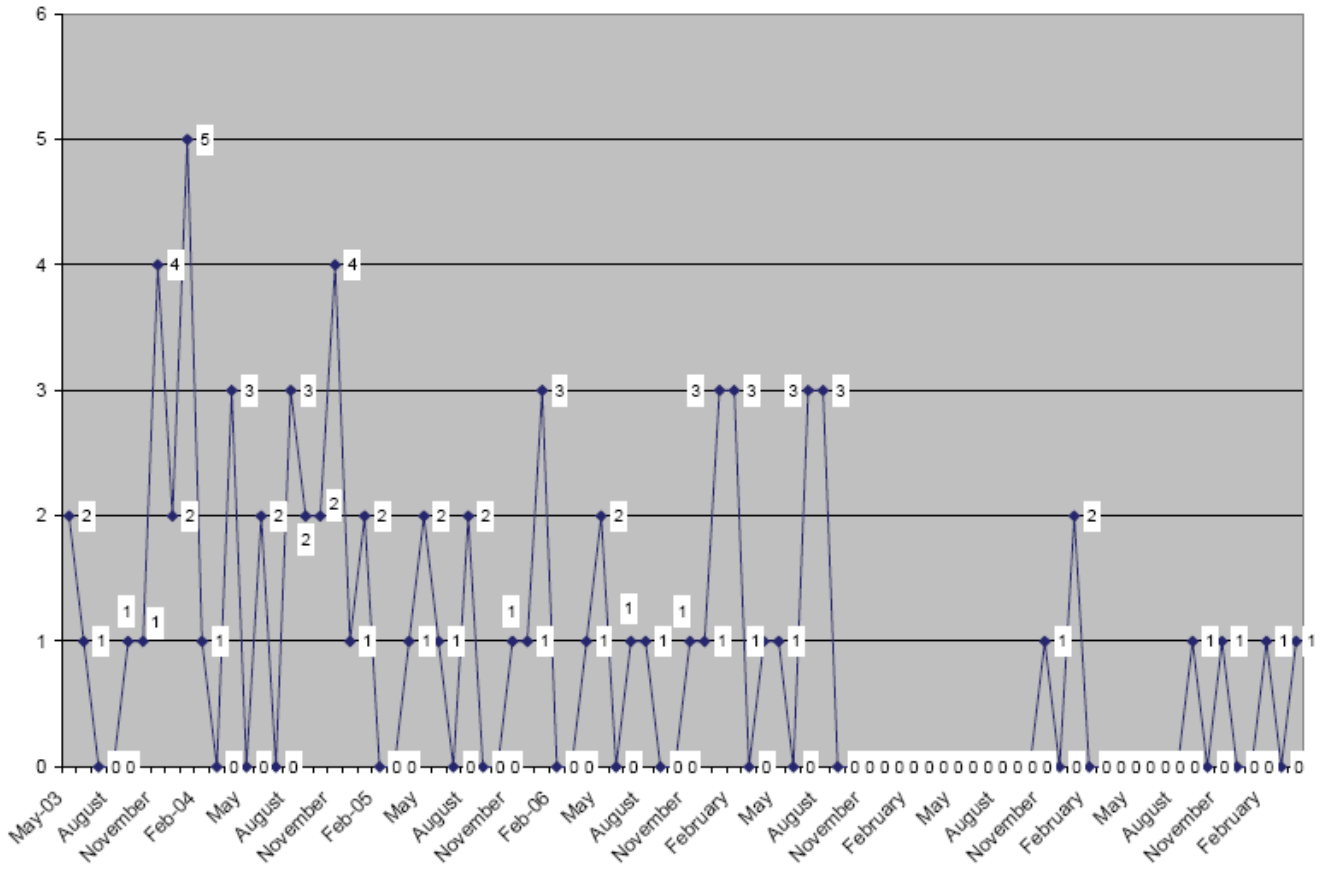
TIPS

- A new initiative for an airborne hardkill capability
- Philosophy; “Defeat incoming threats regardless of guidance technology, if guidance is at all installed”

- Product status: Feasibility assessment

Statistics, Iraq

AMERICAN MILITARY HELICOPTERS DOWNED IN IRAQ[27]

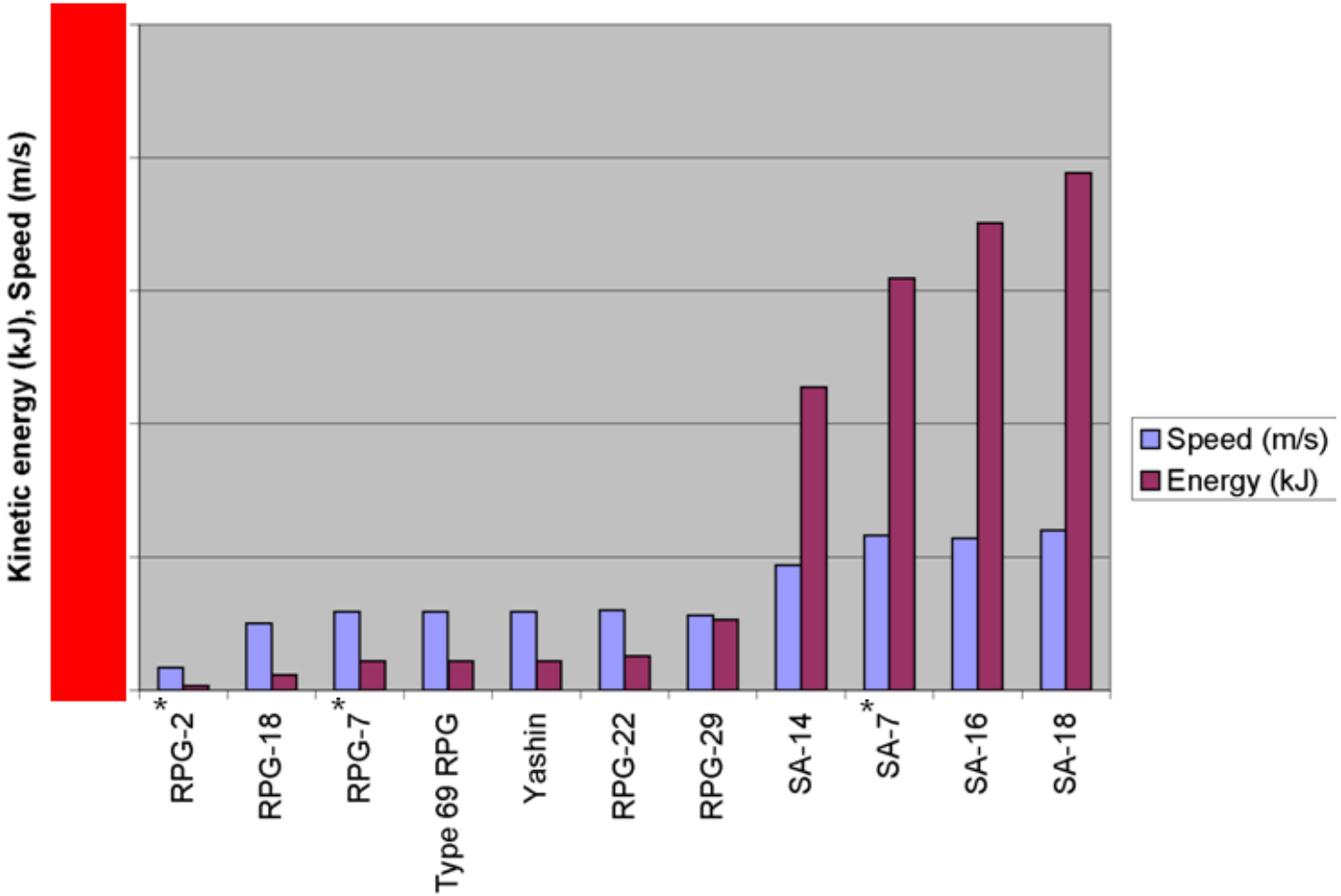


Total through June 30, 2011: 75

NOTE ON AMERICAN MILITARY HELICOPTERS DOWNED IN IRAQ TABLE: Of the 75 helicopters downed in Iraq since May 2003, at least 36 were downed by enemy fire.

Source: Brookings Institute http://www.brookings.edu/saban/iraq-index.aspx

Threat characteristics



Threat characteristics

- Threat characteristics
  - Highly transportable
  - Portable by a single person
  - Designed to fly…
  - On-board propellant
  - Similar physical attributes
  - Similar in-flight velocity
- TIPS to counter threats with the following parameters
  - Speed: 80 – [redacted] m/s
  - Mass: 1,9 – [redacted] kg
  - Body/warhead diameter: 40 – [redacted] mm
  - Altitude: 0 – [redacted] m
  - Range to shooter: [redacted]* – 5000 m

* Envisioned minimum

Considering existing platform infrastructure

- It is desirable to utilize existing platform EW system to the greatest possible extent
  - Philosophy; “Add a new component or function to an EW system and have it work seamlessly with a minimum of required changes to existing system”
  - Considering above aspects results in the following approach for TIPS
    - Already installed Missile Approach Warner system shall be used to detect and declare an incoming threat
    - Already installed CMDS shall be used as infrastructure to launch TIPS interceptor(s)
    - Already installed safety logic (safety pin(s) and WoW) shall be used

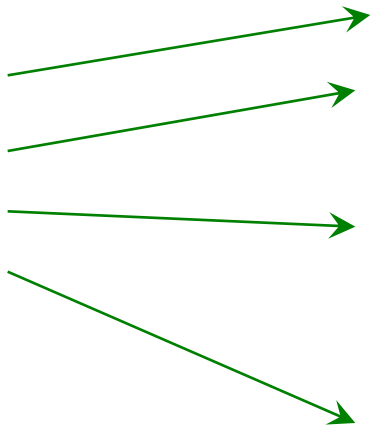
TIPS, what is it?

- Threat Independent Protection System (TIPS*) is not a standalone system but rather new components which are installable into the existing EW system complementing the chaff and flare capability with the introduction of a guided Interceptor adding the capability to defeat threats like RPG's
- TIPS components
  -
- Required updates to existing EW system
  - SW update in the MAW system to feed data to Interceptors via Transceiver
  - Update to the CMDS Mission Data File to consider the new "loadtype"

The new magazine with Interceptors is "just another loadtype" in the CMDS architecture

Addressing the cost / schedule issues
TIPS

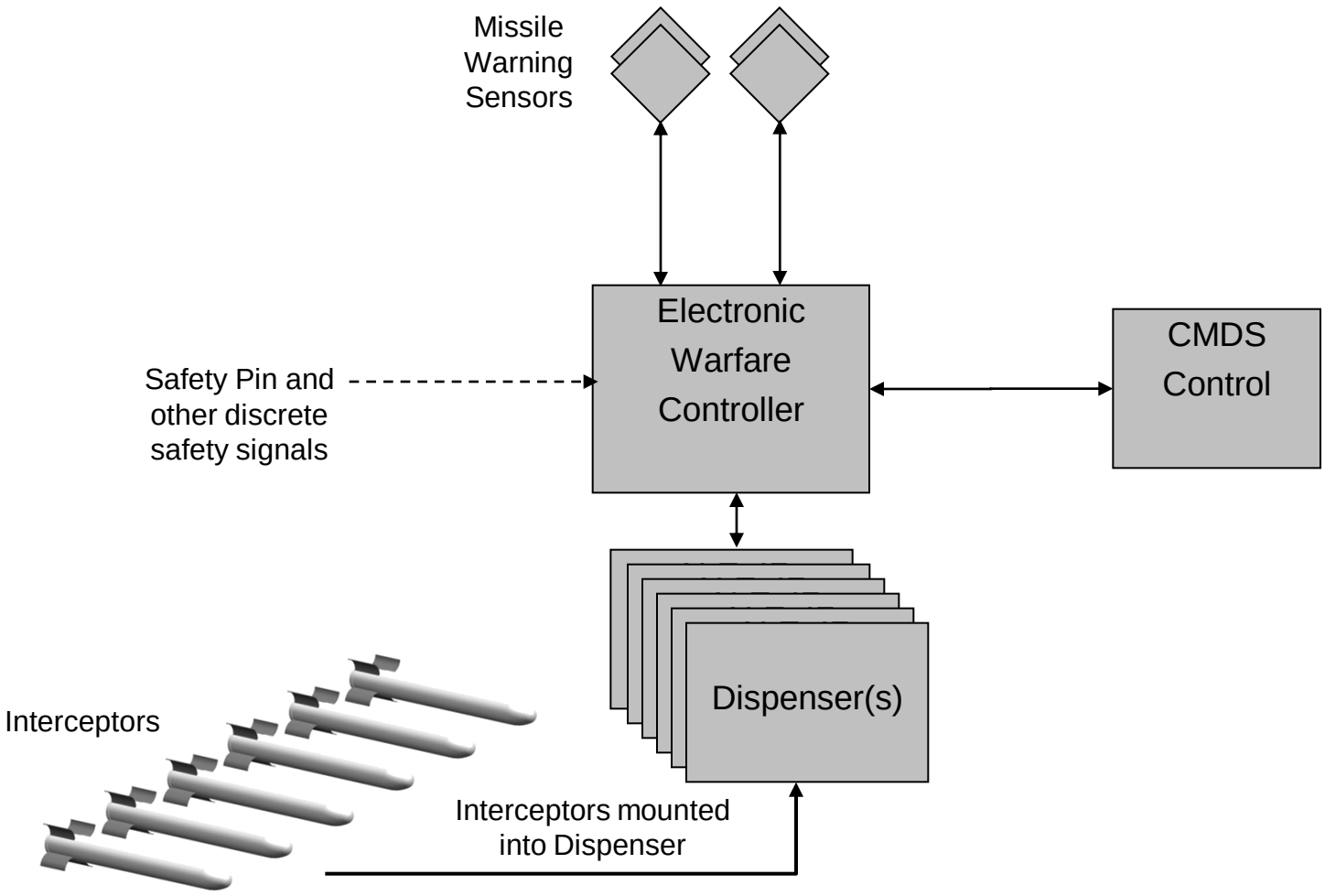
- Interfaces
  - Mechanical
  - Control
  - Power
  - HMI



- Installable into existing dispensers
- Control means
  - Autonomous mode
- Power
  - Power via dispenser
  - Internal power pack
- HMI
  - External BIT indication
  - Dovetail into existing CMDS architecture

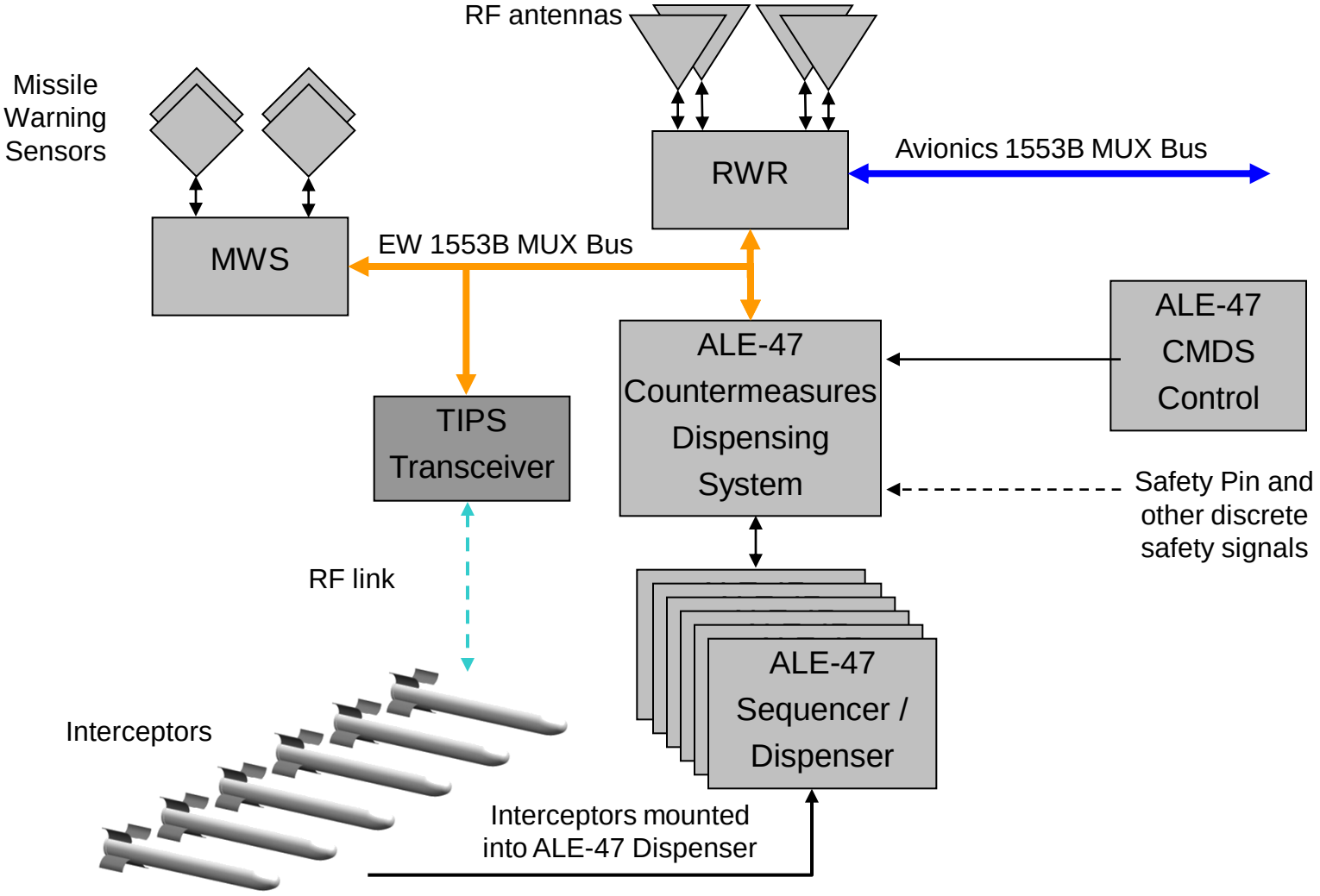
TIPS dovetailing in with IDAS

Example, simplified block diagram



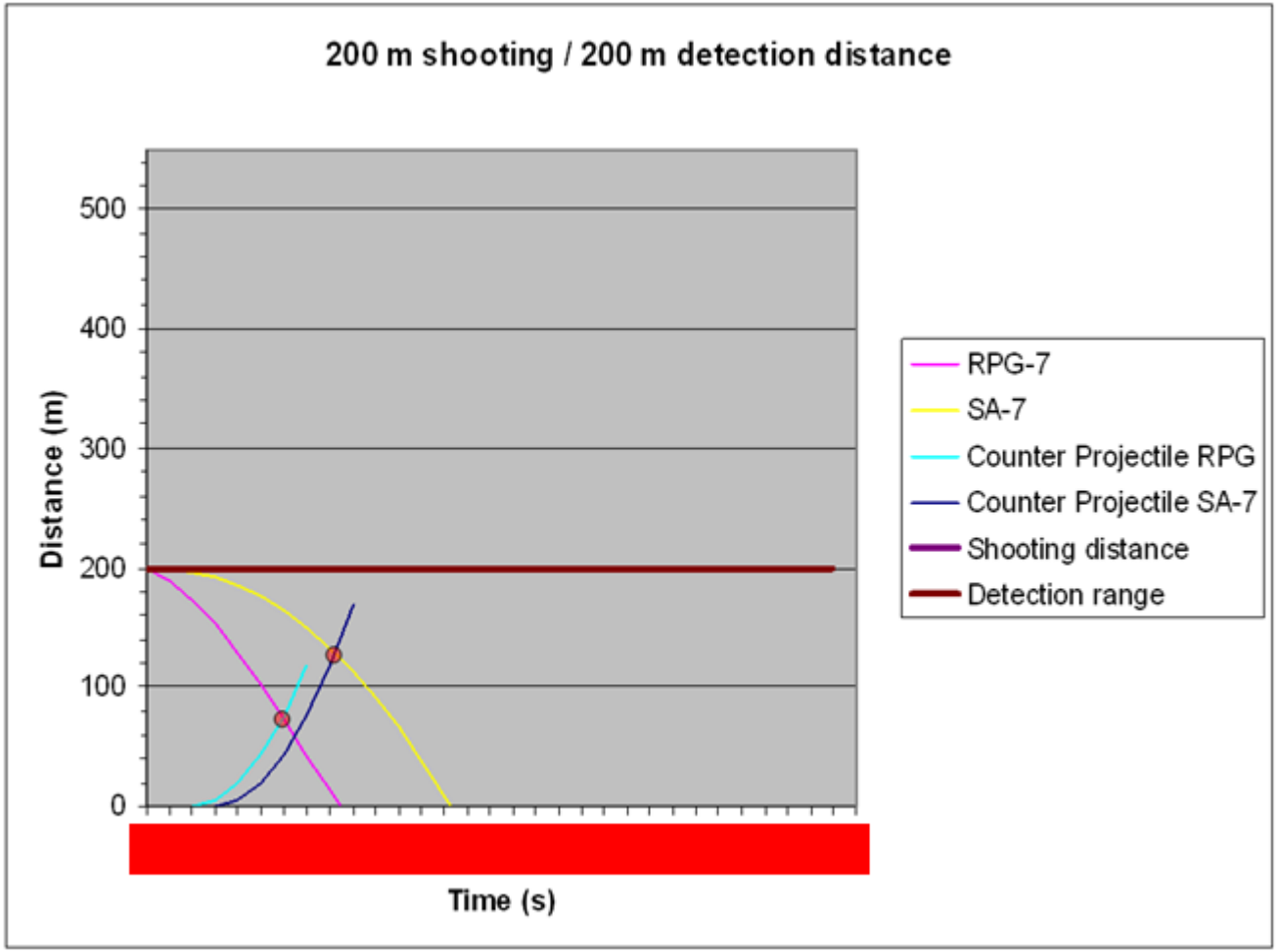
TIPS dovetailing in with ALE-47

Example , simplified block diagram



Interceptor simulation, preliminary data

Stand-off distance in meters



Summary

- Self Protection System products exists that are easy to fit and remove
- These systems provide advanced warning and dispensing
- A Self Protection System is emerging that provide a hardkill capability, TIPS is the name

Questions?

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