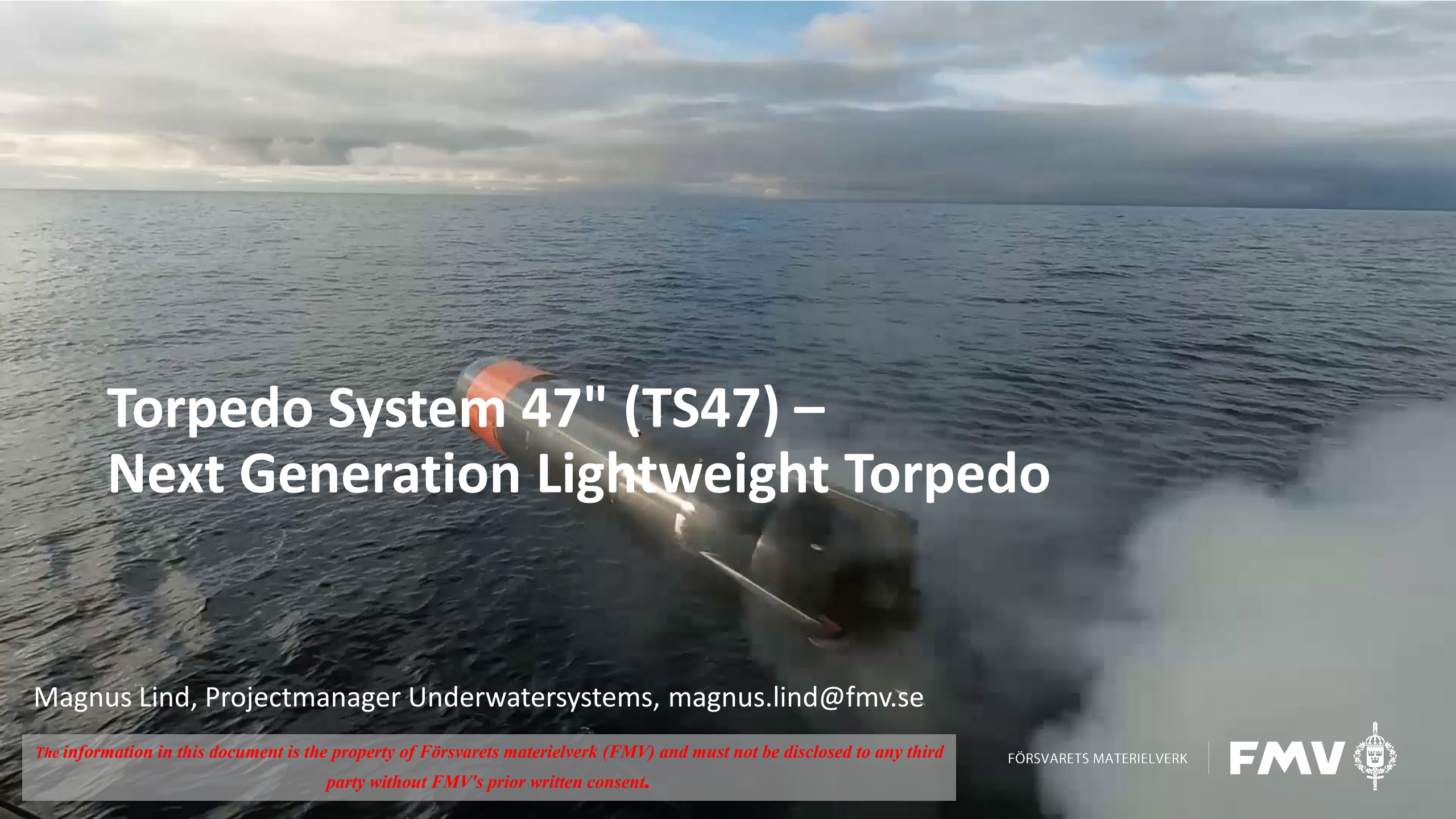

Torpedo System 47" (TS47) – Next Generation Lightweight Torpedo

Magnus Lind, Projectmanager Underwatersystems, magnus.lind@fmv.se

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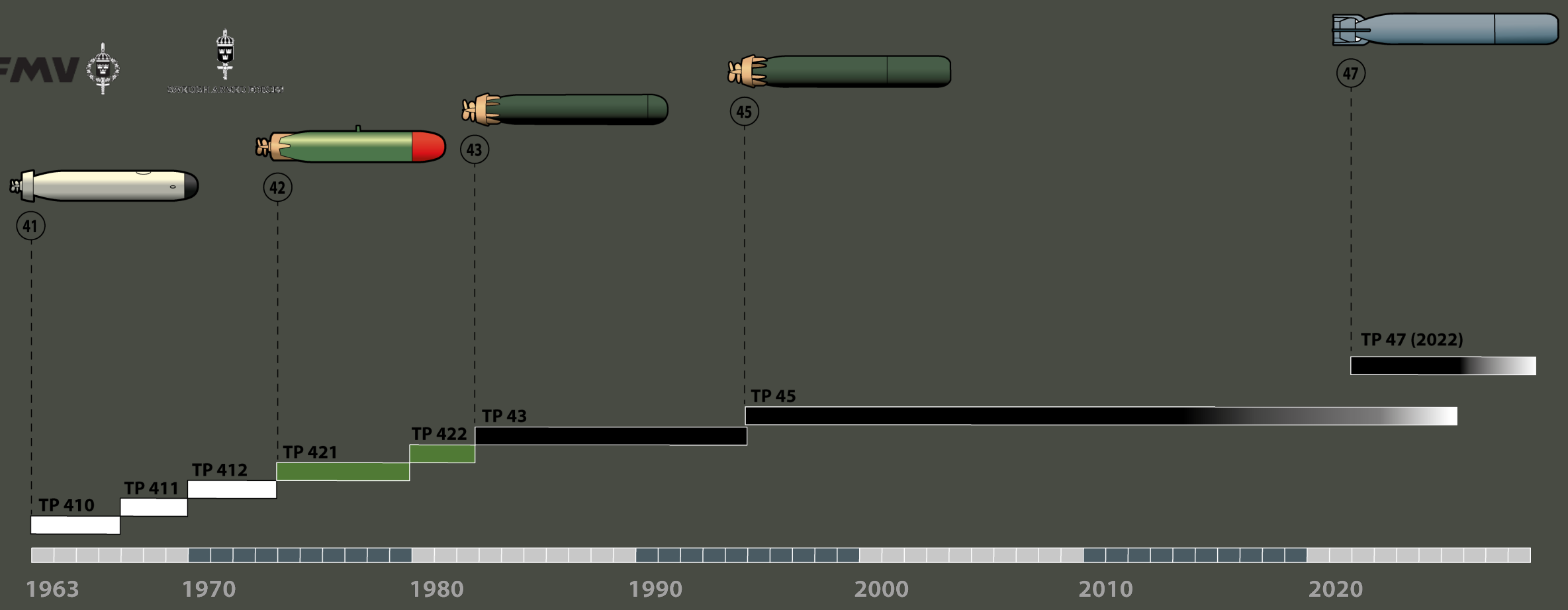
”Torpedsystem 47” (TS47) - Next generation Light Weight Torpedosystem for the SwAF

Update on the TS47, which is developed, produced and optimized for ASW in extreme littoral waters with high sea traffic intensity. (and now even delivered to the SwAF)

Swedish LWT history Timeline 1963–



Torpedo System 47 (TS47)

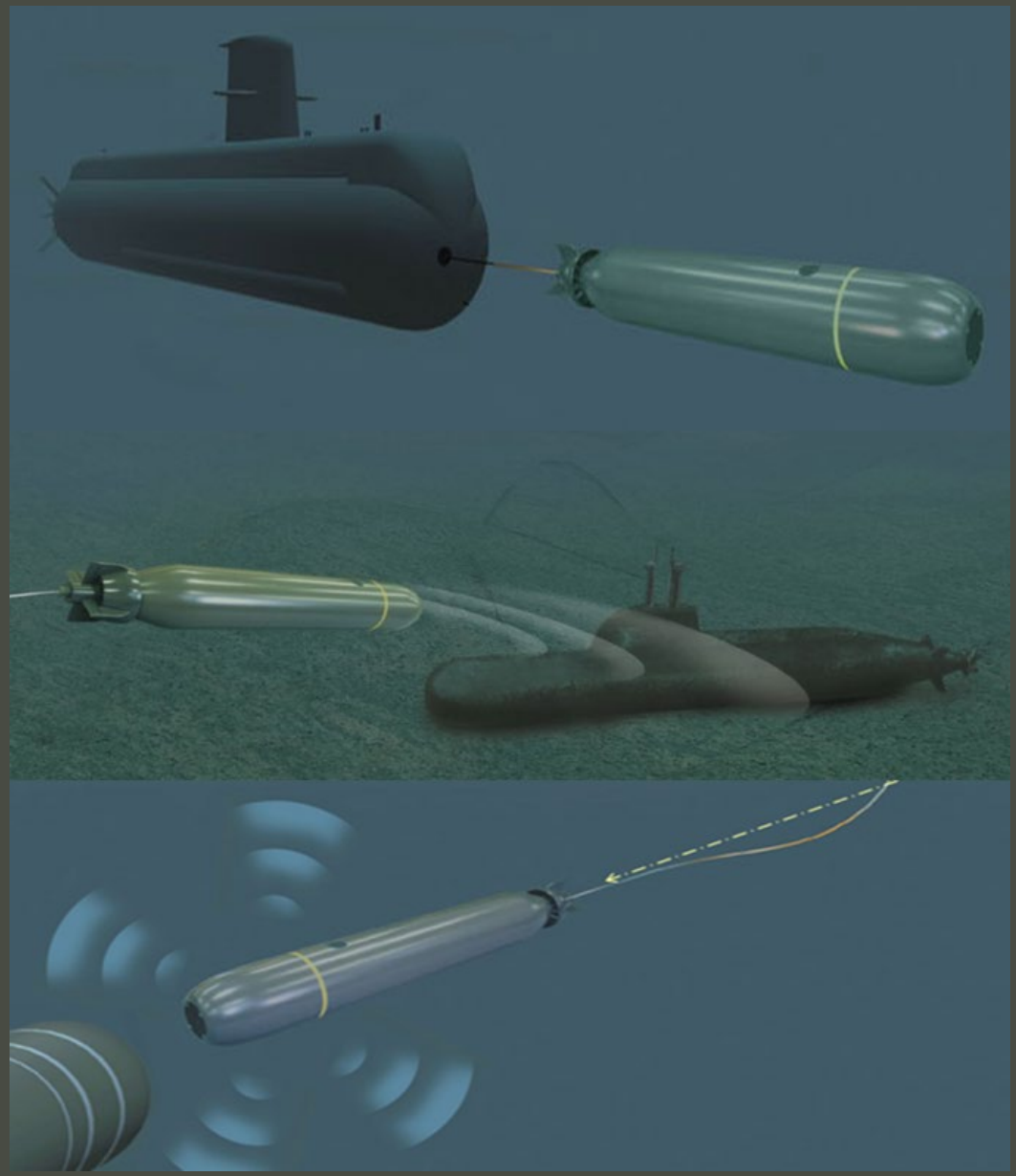
A new generation Lightweight Torpedo System for:

- Anti Submarine Warfare – ASW (primarily)
- Anti Surface Ship Warfare – ASuW (secondarily)
- Torpedo defense

Key functionality:

- Shallow water operations (Baltic sea)
- Complex scenarios
- Low speed capability
- Communication capability
- A modular design to accommodate future upgrades and new functionalities
- Adaptation to international missions

Torpedo 47 in progress to replace the currently operational Torpedo 45.



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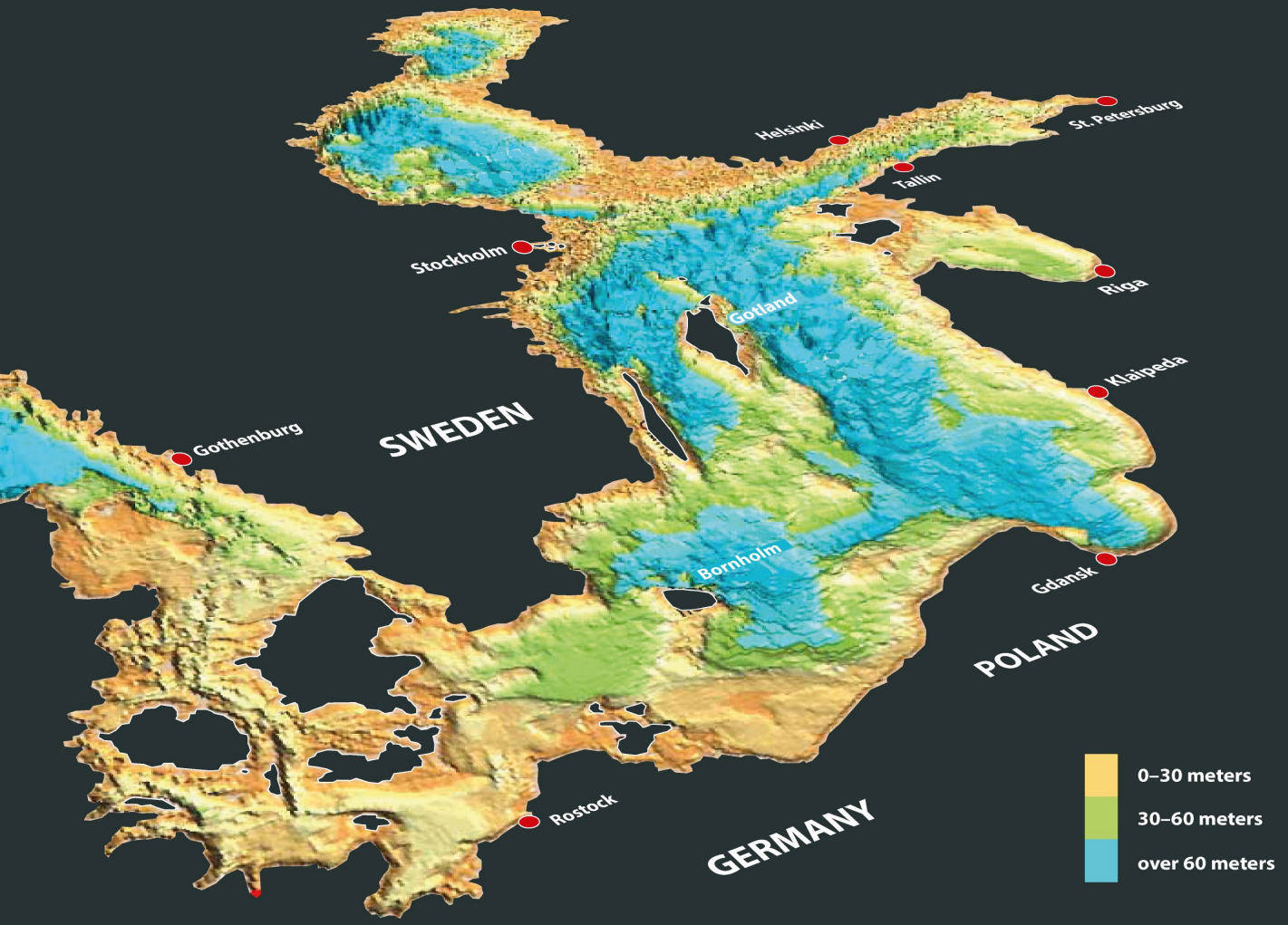
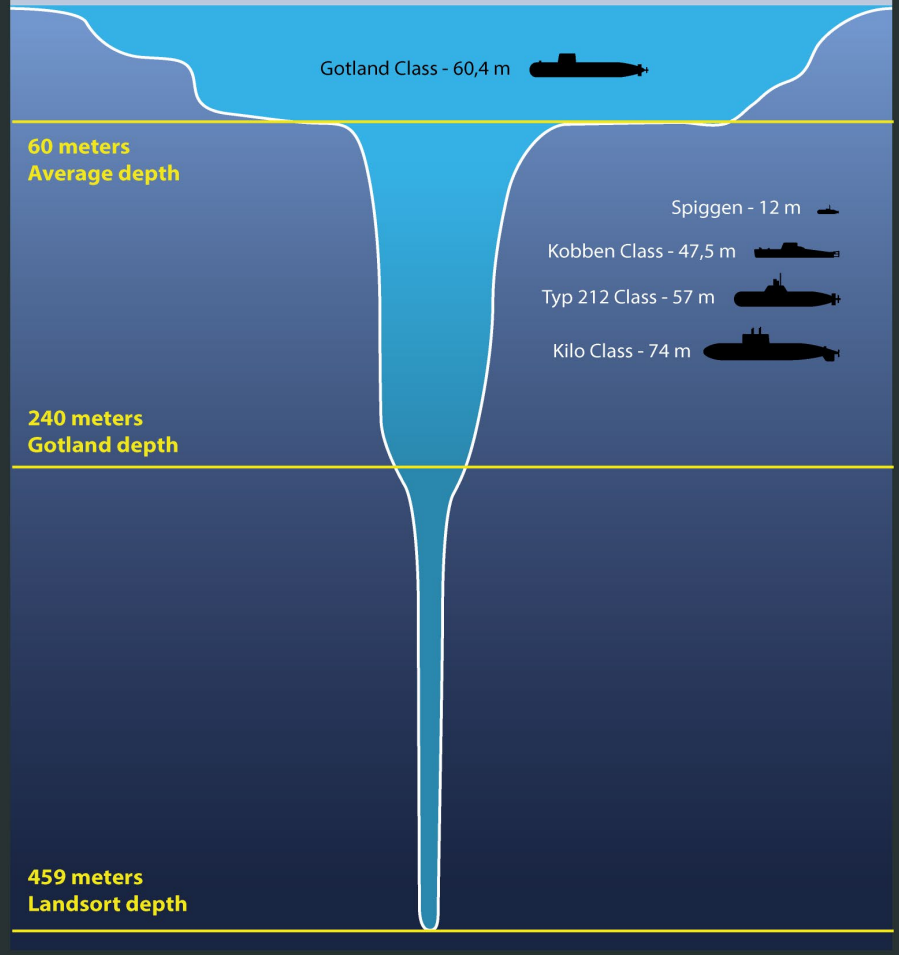
Underwater topography of the Baltic Sea



Submarines that normally operate in the Baltic Sea



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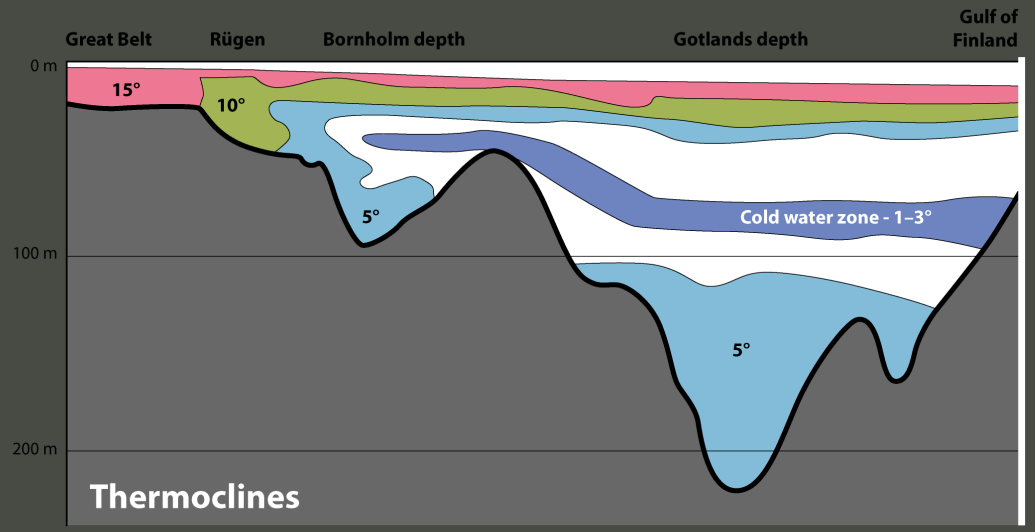
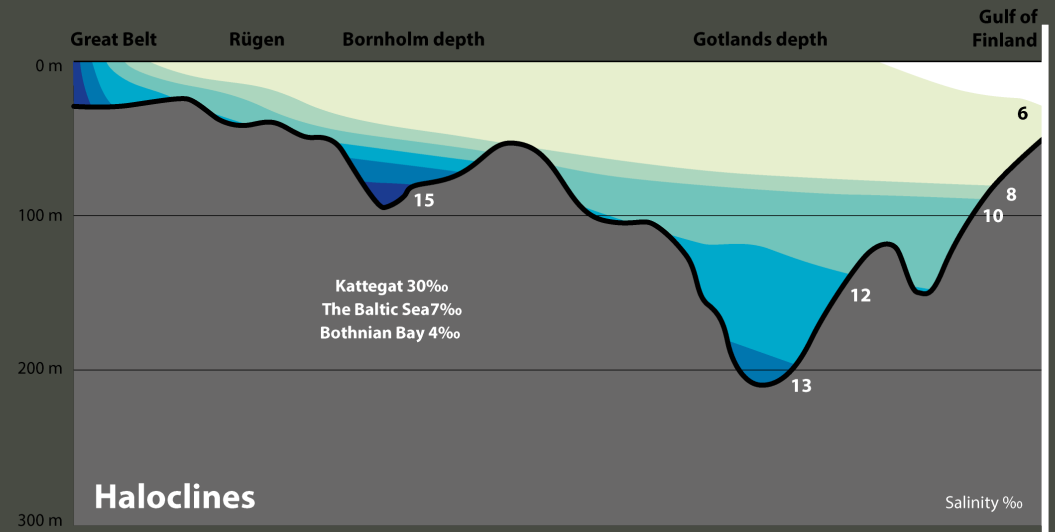
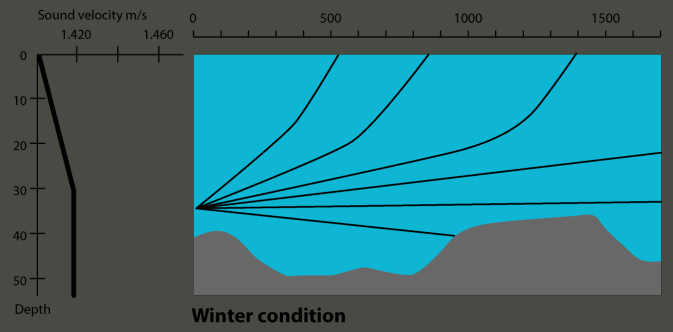
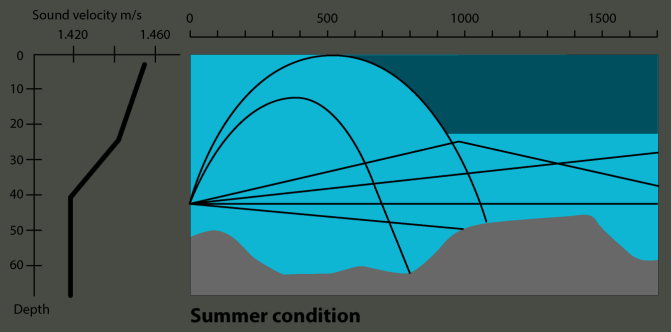
SOFAR channels in the Baltic Sea

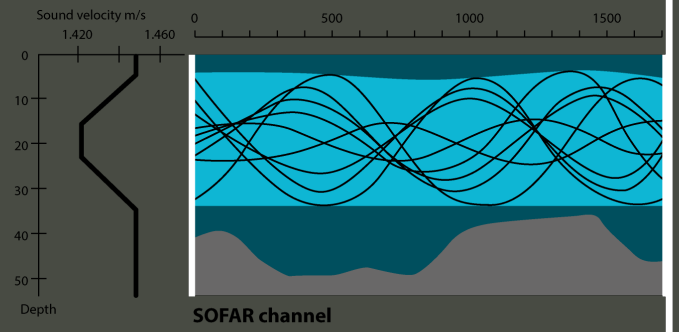
Representation of the conditions in the Baltic Sea a typical summer day. The water mass is layered due to difference in salinity and temperature. Between some layers channels form where sound can travel very long distances. In these channels submarines prefer to use their sensors.





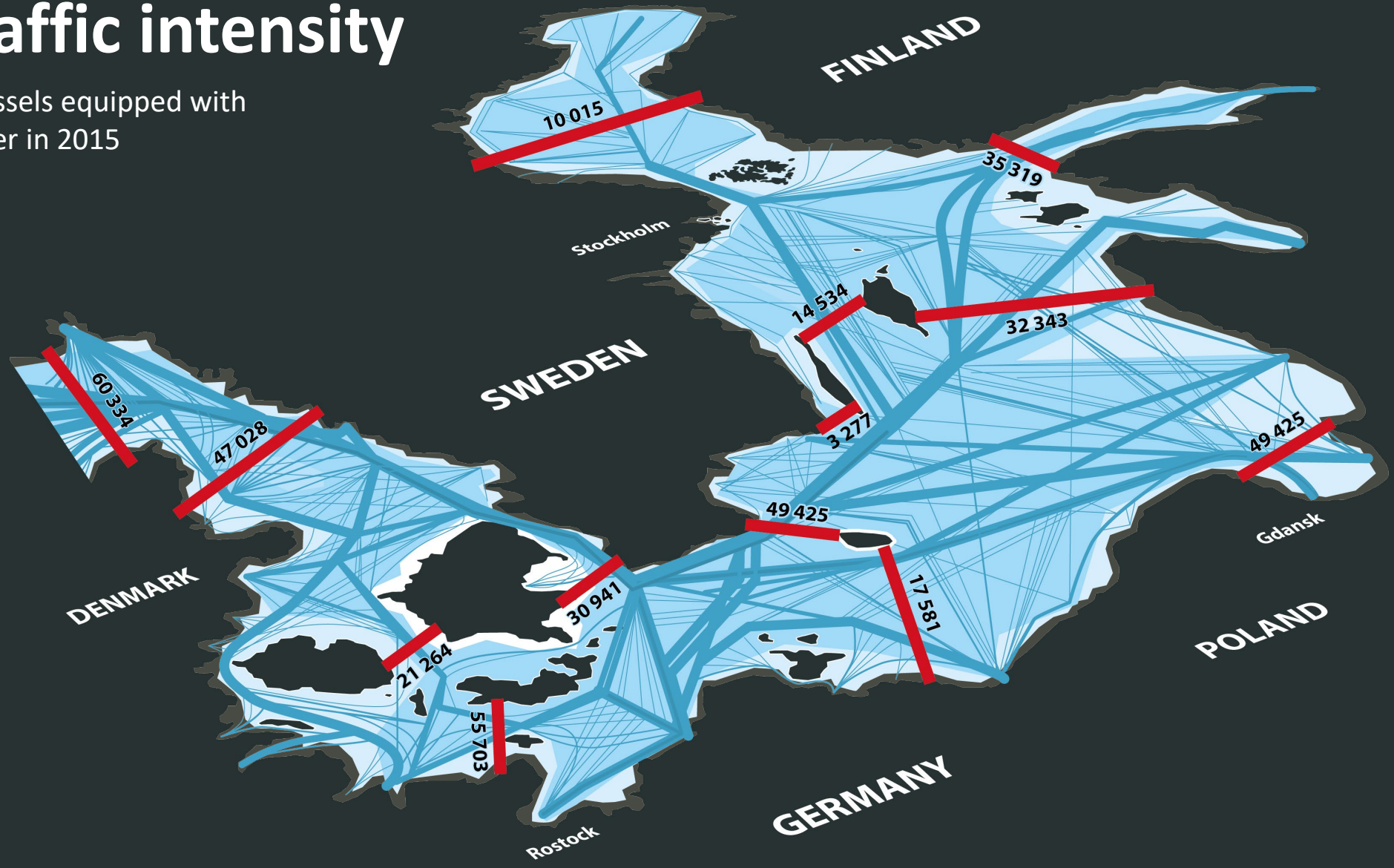






Sea traffic intensity

Passages of vessels equipped with AIS-transponder in 2015



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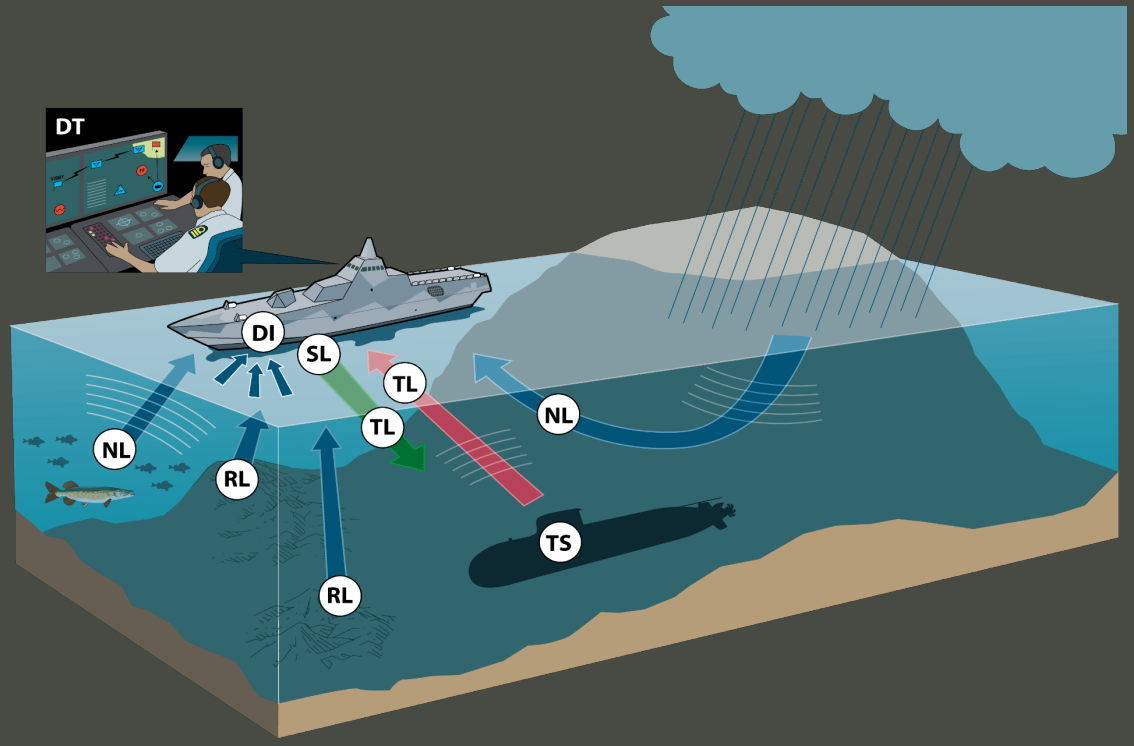
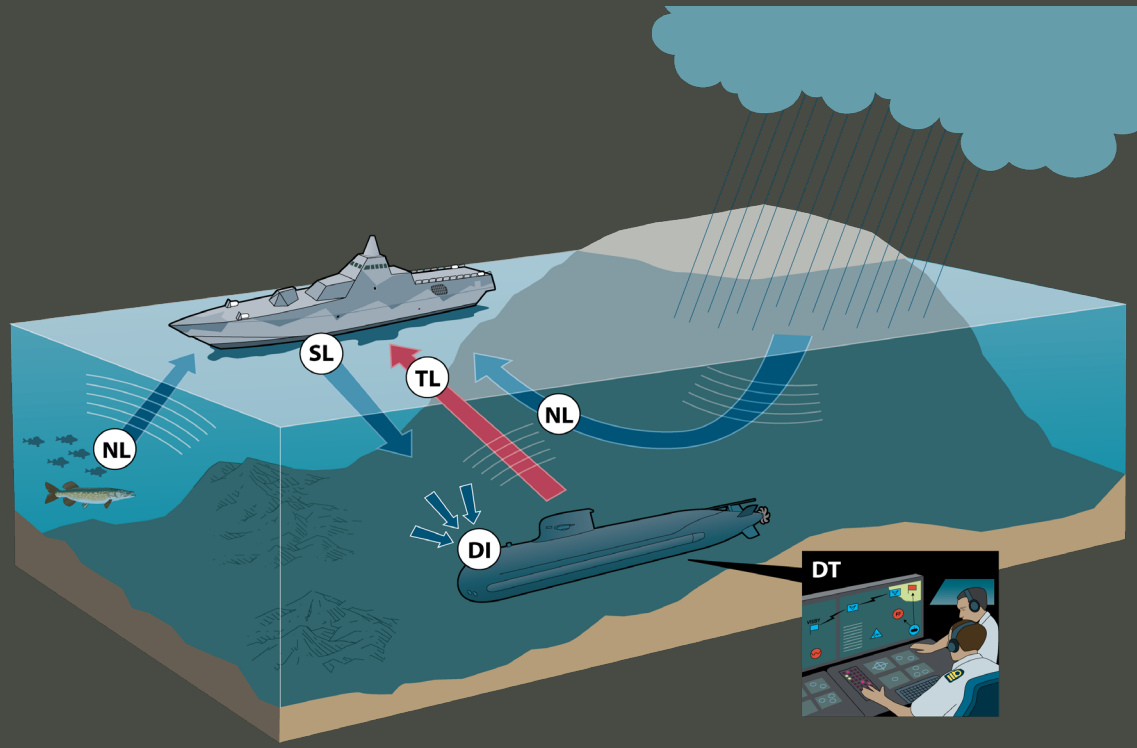
Active & Passive sonar performance prediction





SL - Source Level
NL - Noise Level
DI - Directivity Index

TL - Transmission Loss
DT - Detection Threshold
RL - Reverberation Level

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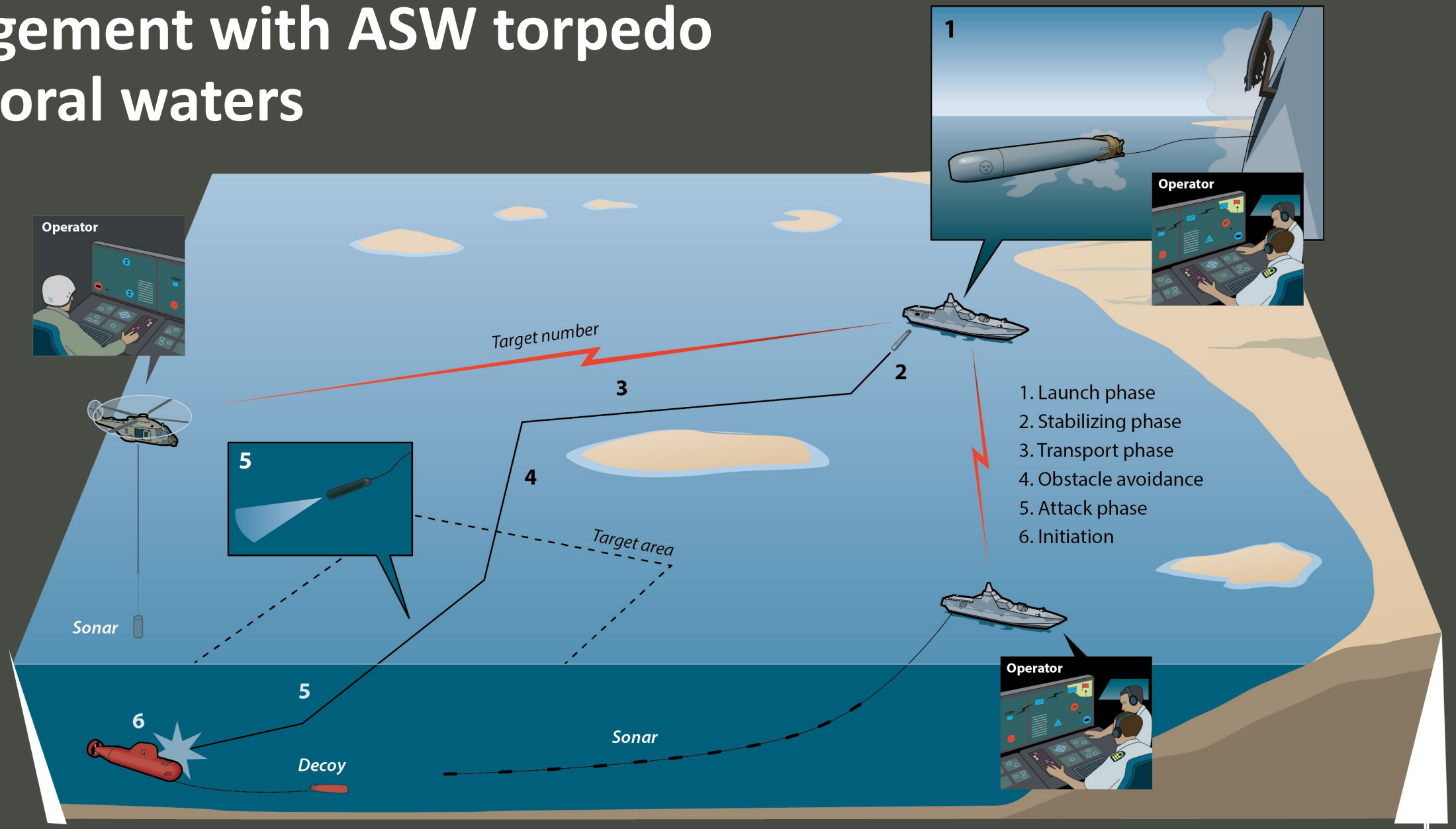
Engagement with ASW torpedo in littoral waters



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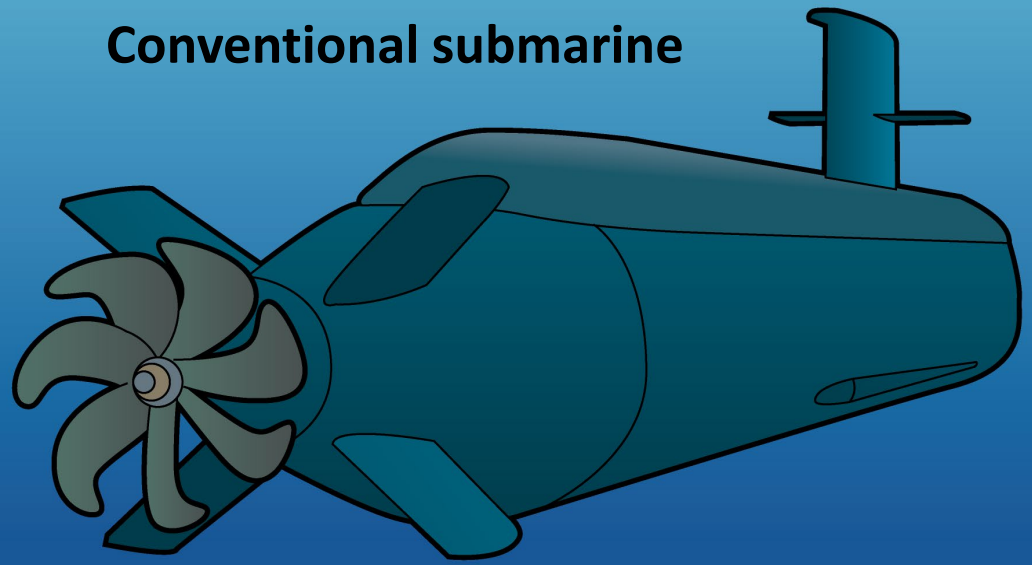
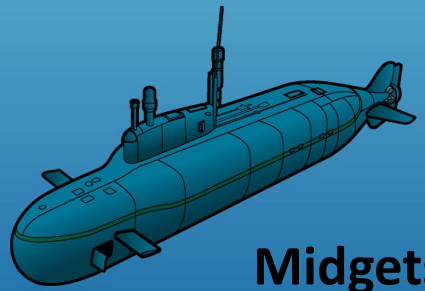
Possible threats

Swimmer Delivery Vehicle (SDV)

Conventional submarine





Midgetsub

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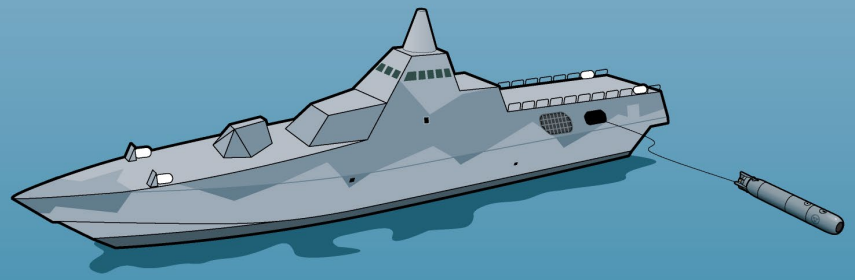
Overview of launching platform types

Helicopter Xx (prepared for)

(ASW Configuration)

- Use own sensors or relayed information to locate and track target.
- Launch torpedo 47 with wire guidance hovering or as fire and forget.



Visby & Gävle Class Corvette

- Use own sensors or relayed information to locate and track target.
- Launch torpedo 47 with wire guidance or as fire and forget.

Gotland, Södermanland and Blekinge Class Submarine

- Use own sensors to locate and track target.
- Launch torpedo 47 with wire guidance or as fire and forget.

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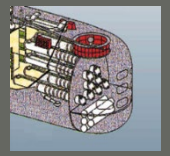
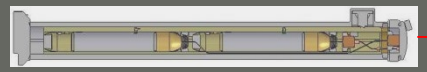
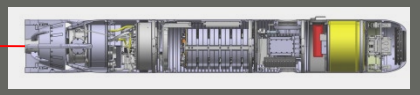
Torpedo System 47 - Definition




Sonar → Combat Management System → Torpedo System

Torpedo Interface System → Torpedo Tube → Communication System → Torpedo

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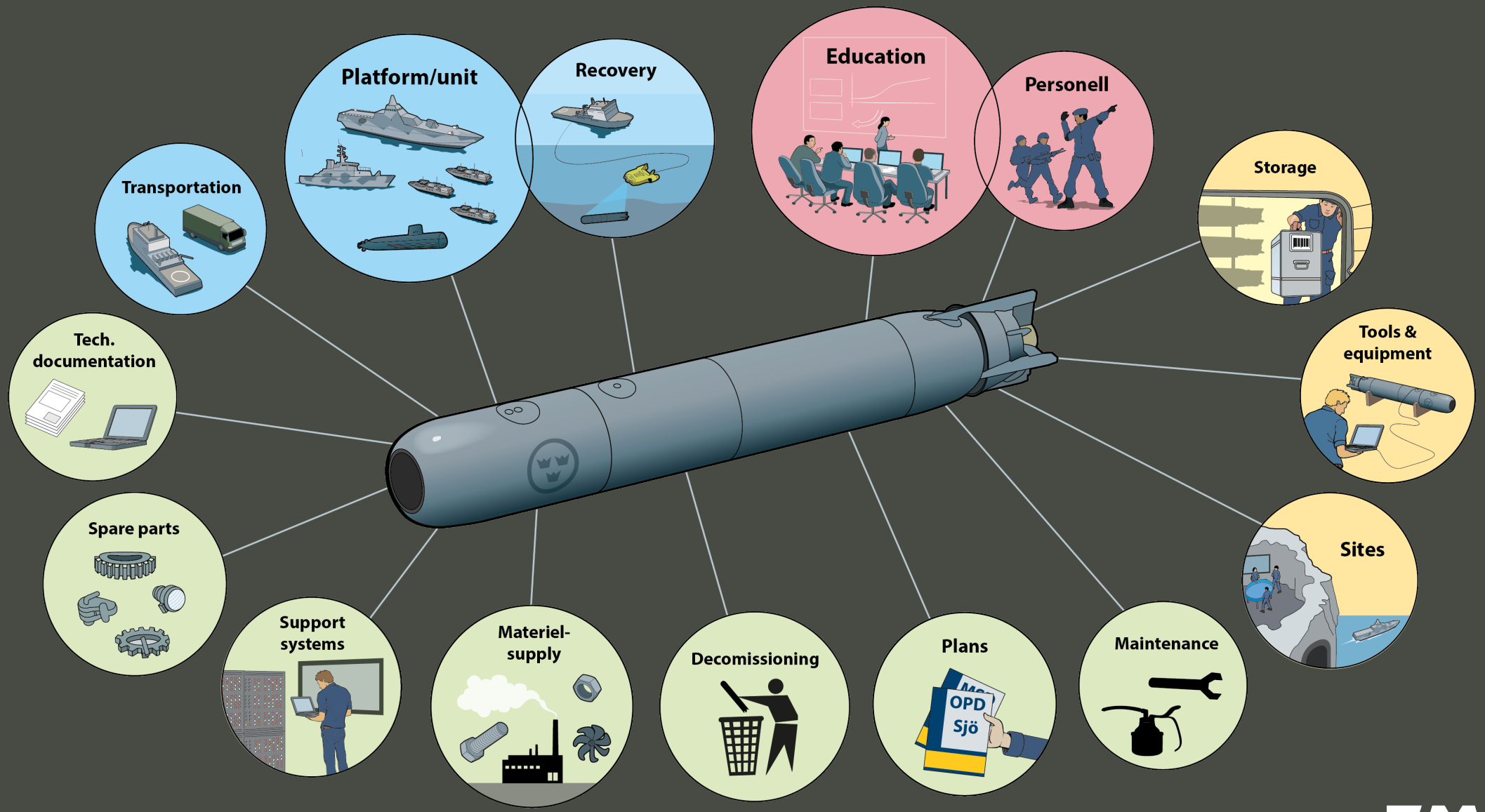
Torpedo System 47 - Definition



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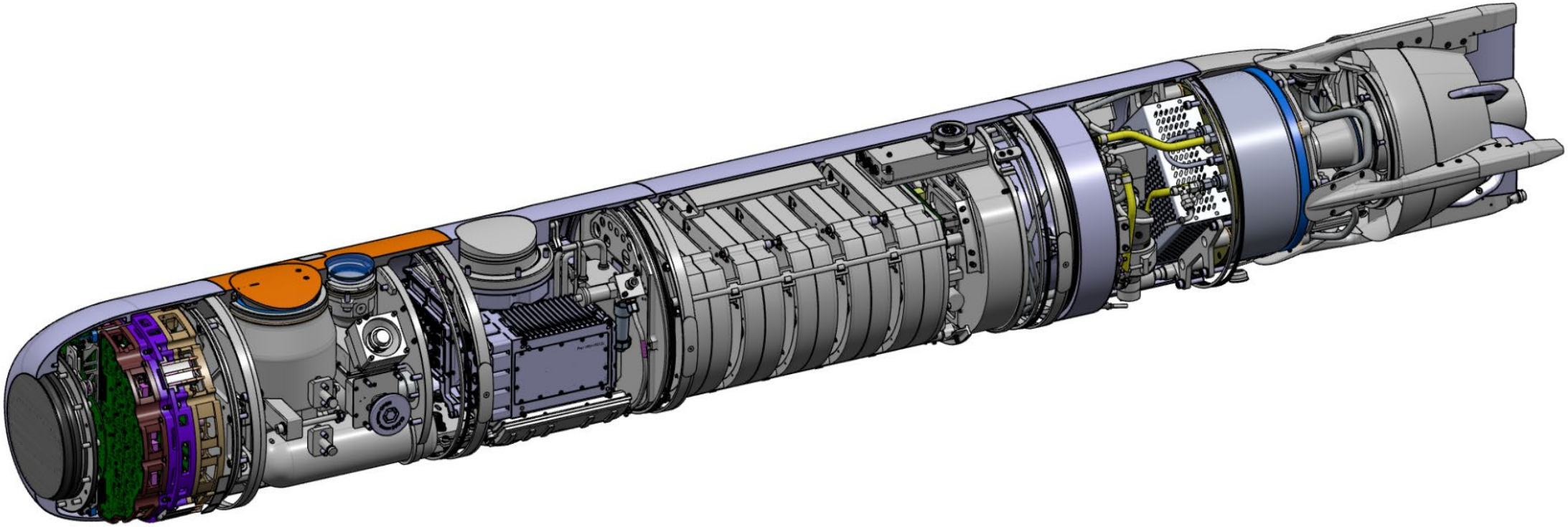
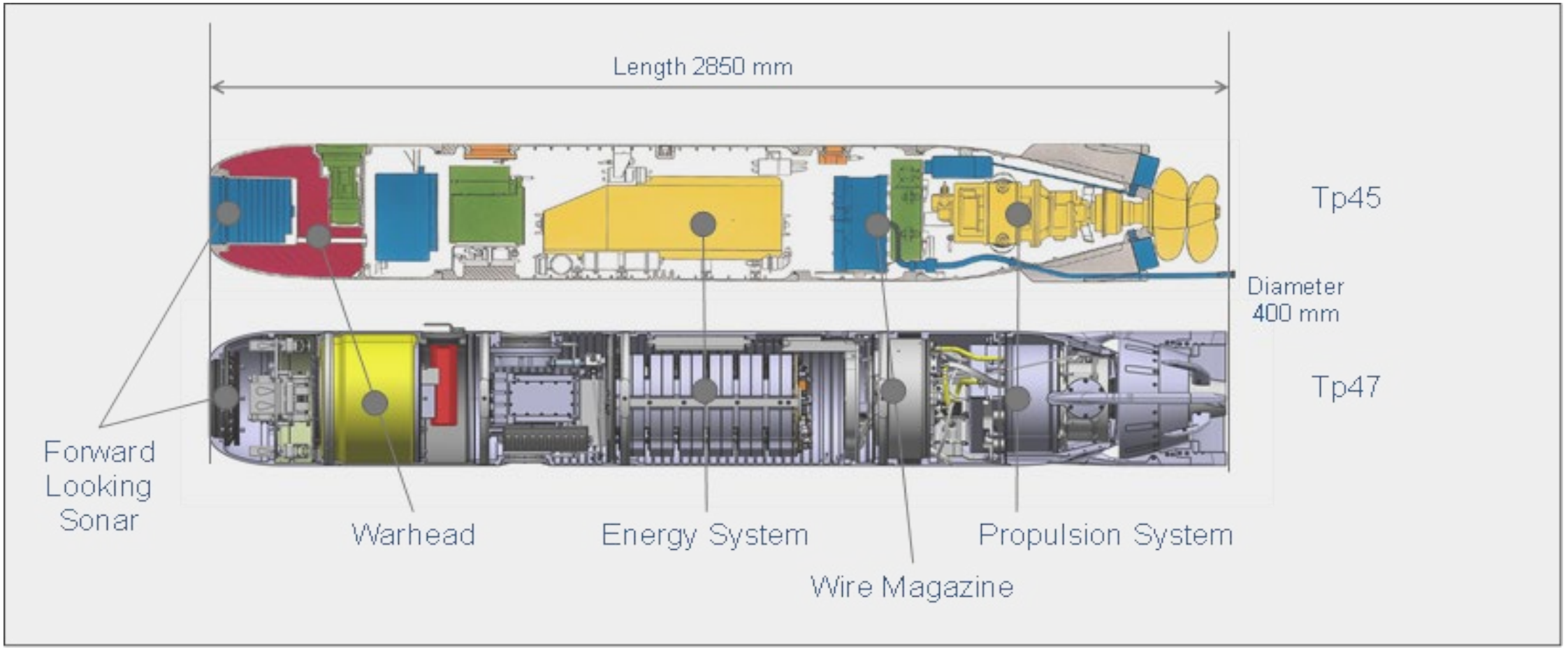
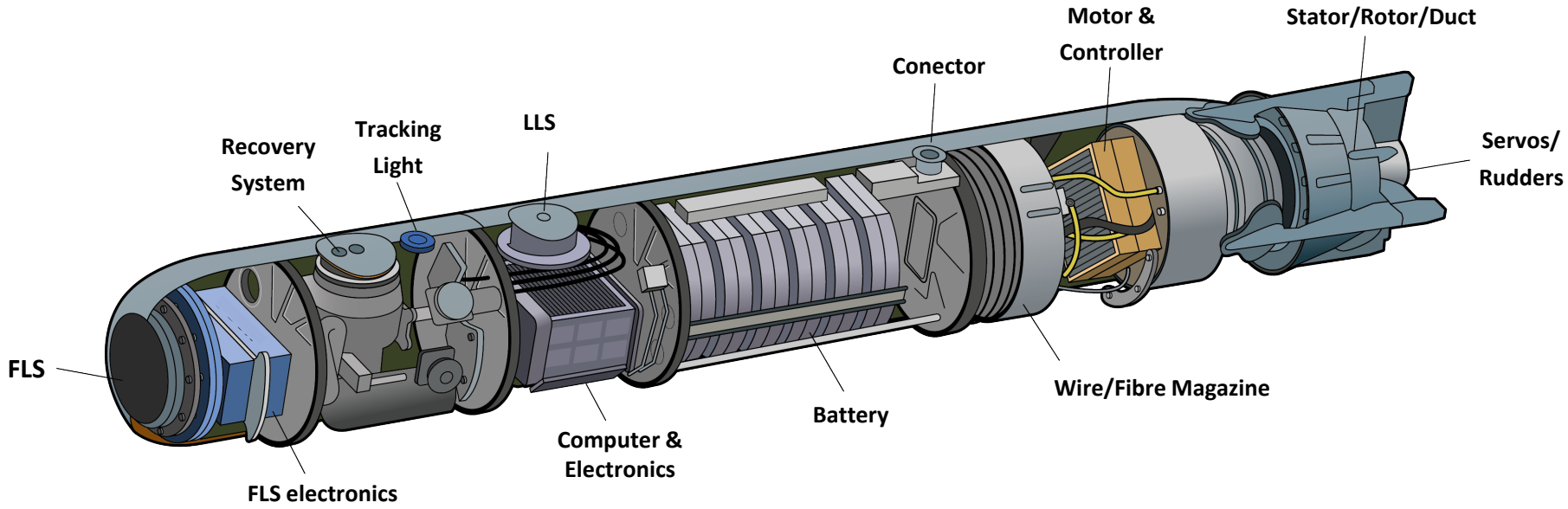
Torpedo 47



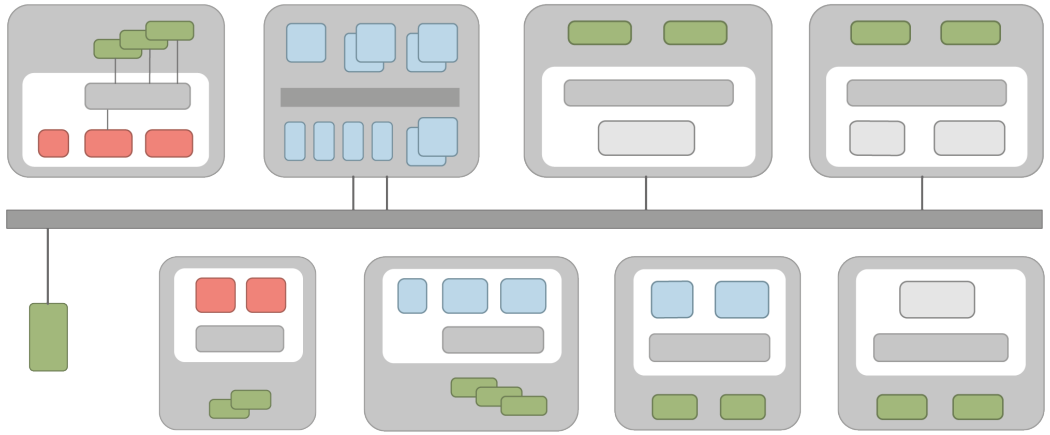
Torpedo 45 vs Torpedo 47



Torped 47 – design principles and performance



Dimensions	400 mm x 2850 mm
Weight	Ca 340 kg
Speed	10- to ≥35 kts Prepared for≥45+ kts
Endurance	≥ 20 km (>1h) Prepared for ≥ 50 km
Battery	LiFePO4, >100 recharging
Propulsion	Electronic DC-motor / Pumpjet
Homing system	Active & Passive (Fully Digital) Prepared for HF
Warhead	IM compliant, omni-directional, PBX
Communication	Galvanic wire, Prepared for Optical fiber



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Homing System (MS5)

Next generation Swedish Homing System

FLS (Forward Looking Sonar)

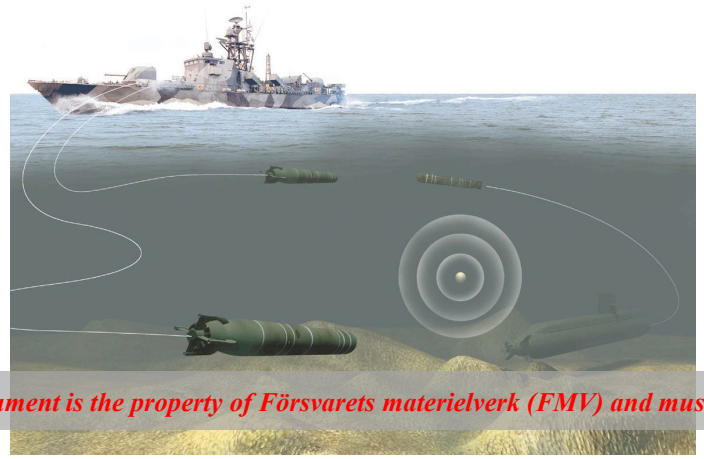
Fully digital

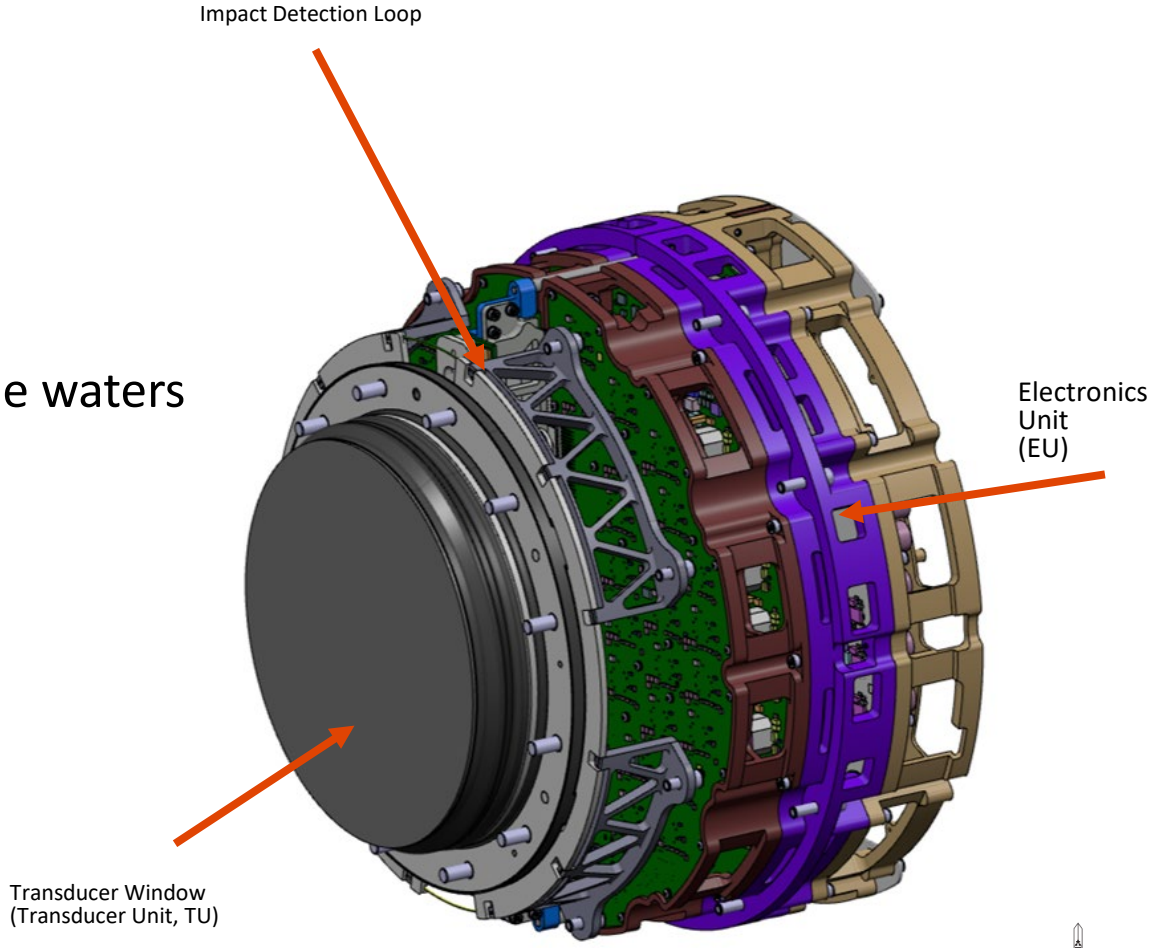
Active/passive

Flexible beamforming and signal processing

Optimized for the Baltic Sea but with the capability in blue waters

- Higher Fq compared to other ASW torpedoes
- Resolution prior before range.





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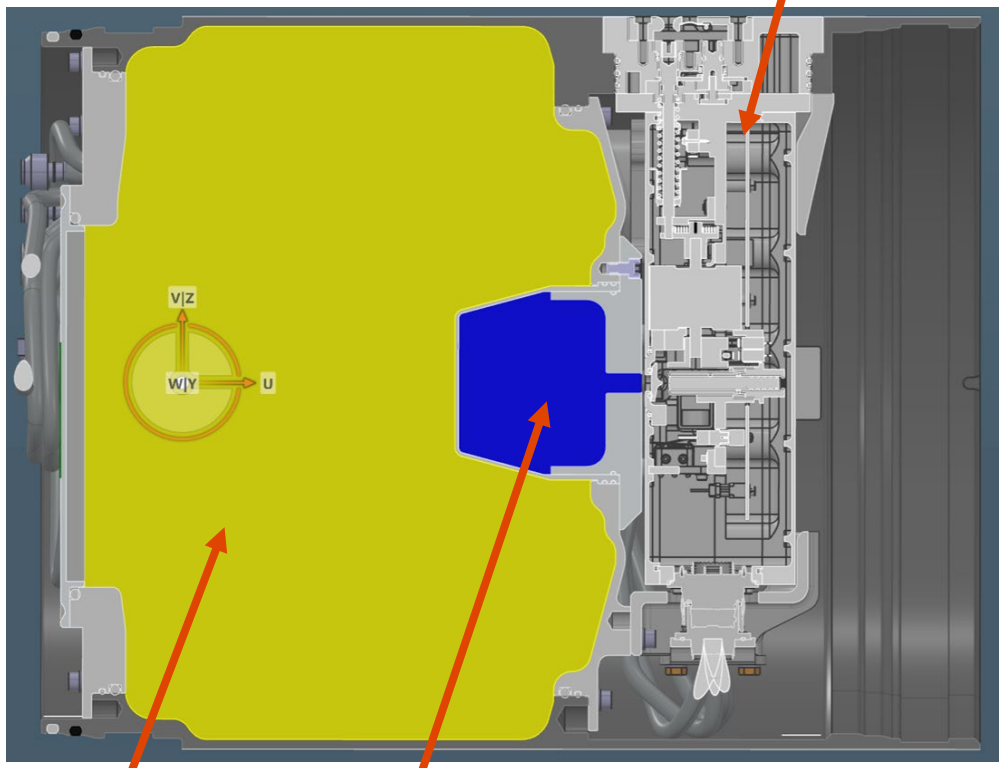
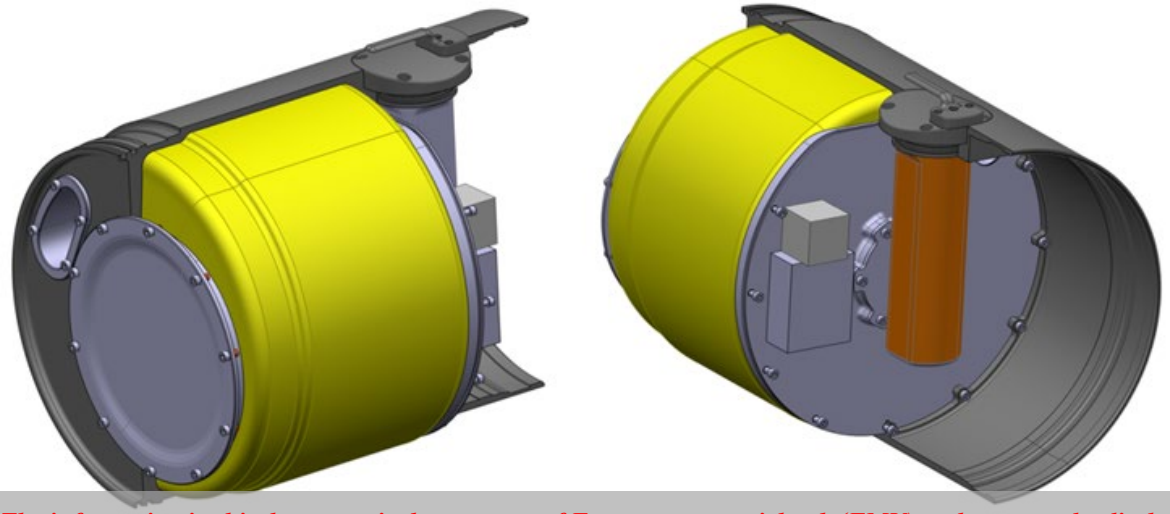
Warhead Module

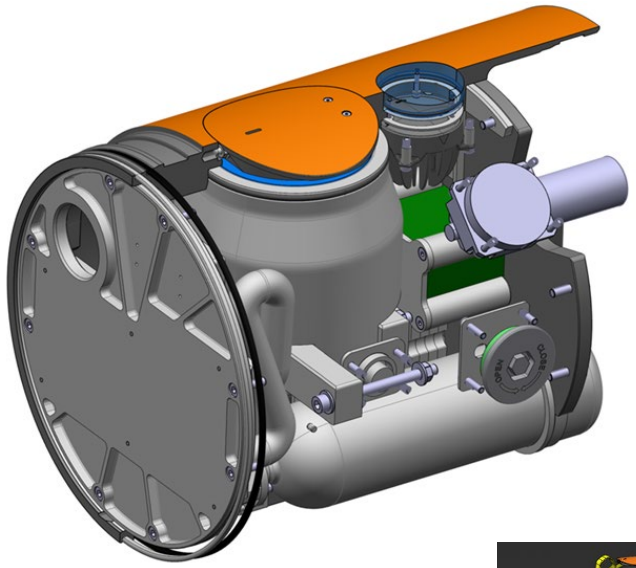
- Explosives
  - IM-classed PBX, Bulk Charge 50+ kg
- Booster
  - IM-classed
- Safety, Arming and Initiation (SAI) Unit
- IM (Insensitive Munition) acc. STANAG

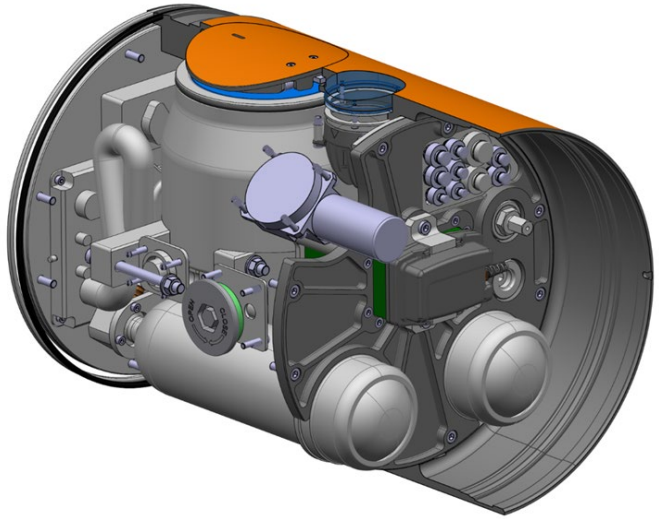


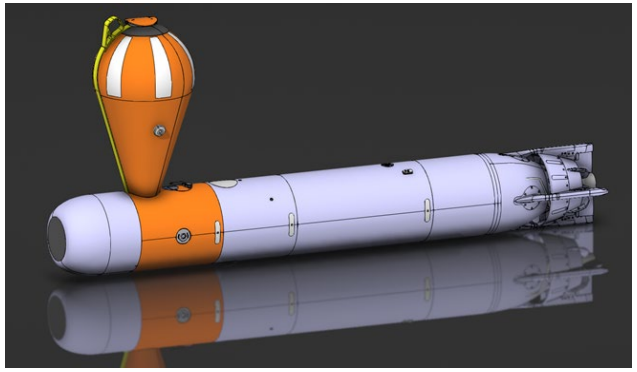


Exercise Module

- Inflatable Balloon System
  - Balloon
  - Compressed Air Bottle
  - Air Release Valve
- Recovery Strap
- Tracking Light
- Acoustic Pinger
- Pressure Switches (Depth Guards







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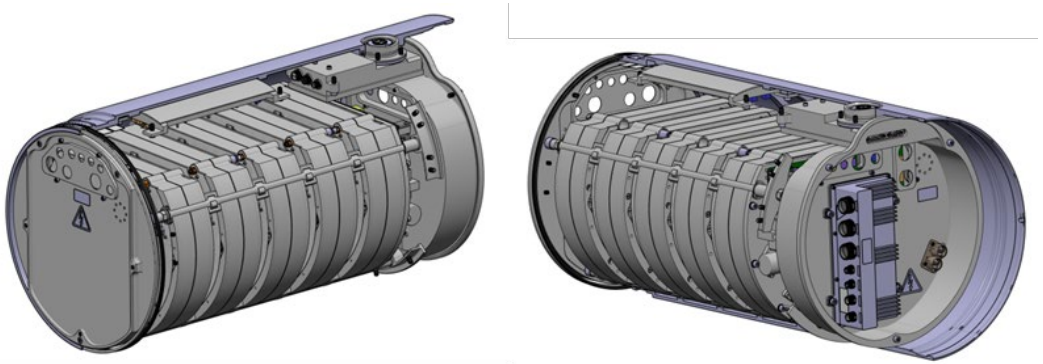
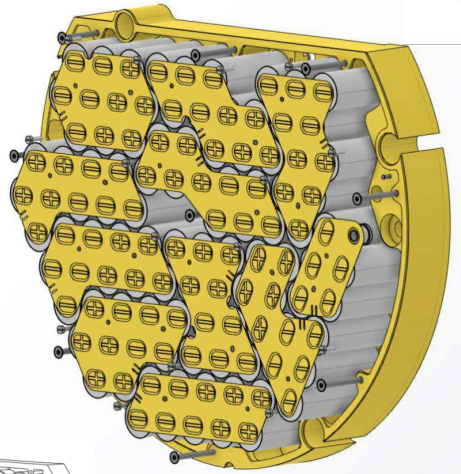
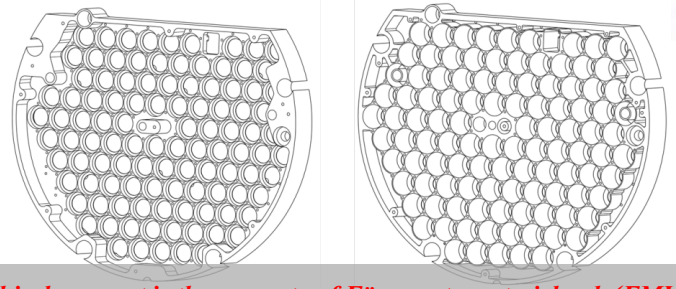
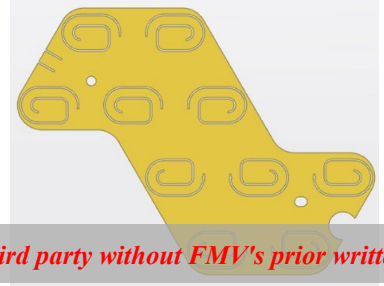
Energy Module

Weight:	55 kg
(Complete Battery Module - 84 kg)	
Cells	525 (5P105S)
Cell Type:	AN123 (LiFePO4)
	(Lithium Iron Phosphate)
Energy Contents	4.2 kWh
System Voltage	346 V









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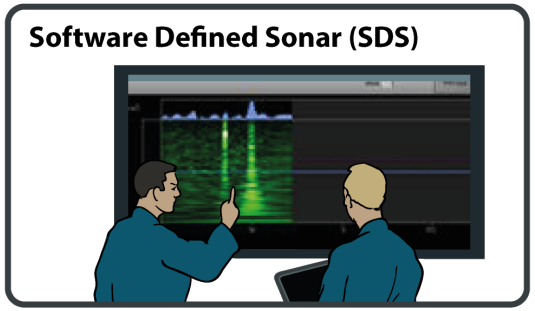
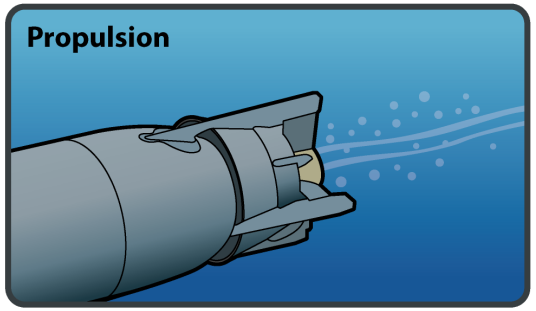
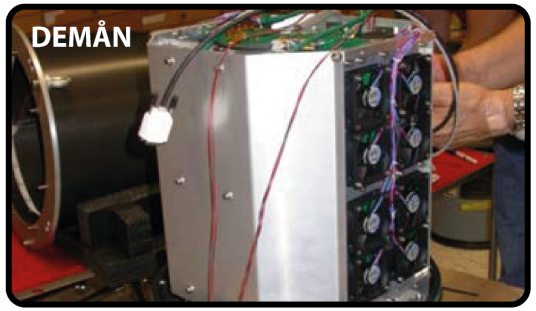
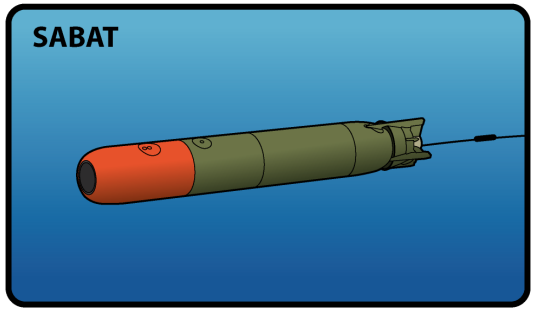
Critical success factors in torpedo system development

Development projects since Torpedo 45 was delivered









Activity/Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Design Environment for Pump-Jet													
Study Propulsion TP45													
Software Defined Sonar (SDS)													
DEMAN Demonstrator Homing System													
Mod Guidance Functions TP62													
Software for new Proximity Fuse													
Threat Adaptation TP62													
Upgrade ZoKITS TP62													
Sapphires Phase 3													
Development and Manufacturing of AUV62-SABAT													
Export Contract AUV62-AT													
NLTG													
NLT Phase 2													

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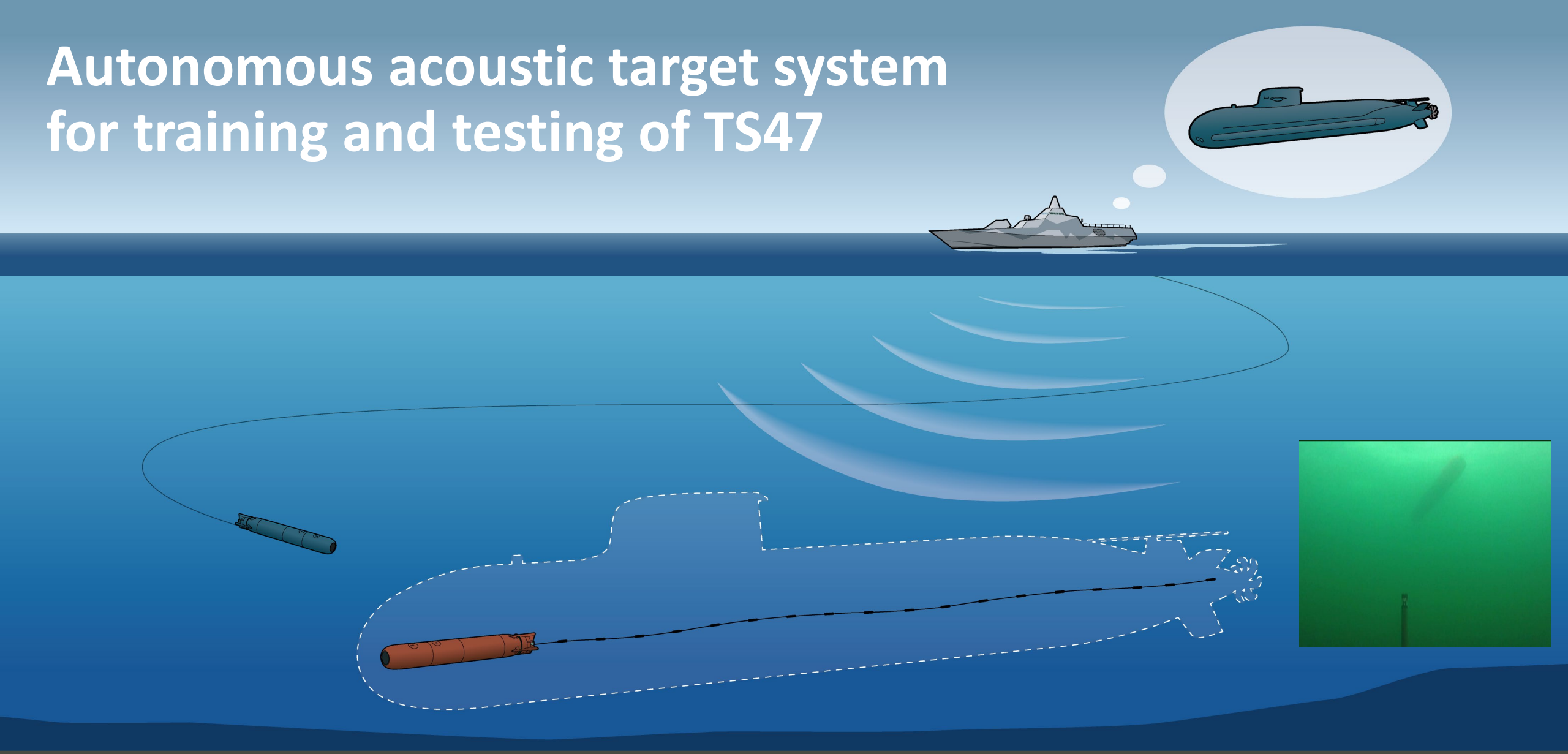
Autonomous acoustic target system for training and testing of TS47



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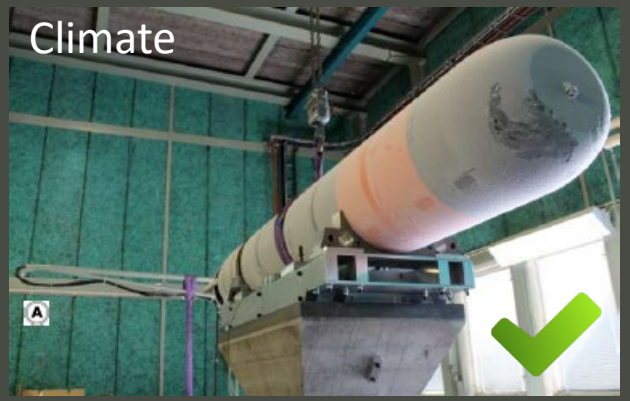
Verification of Requirements



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Sea trials

"Sjölöken XX"

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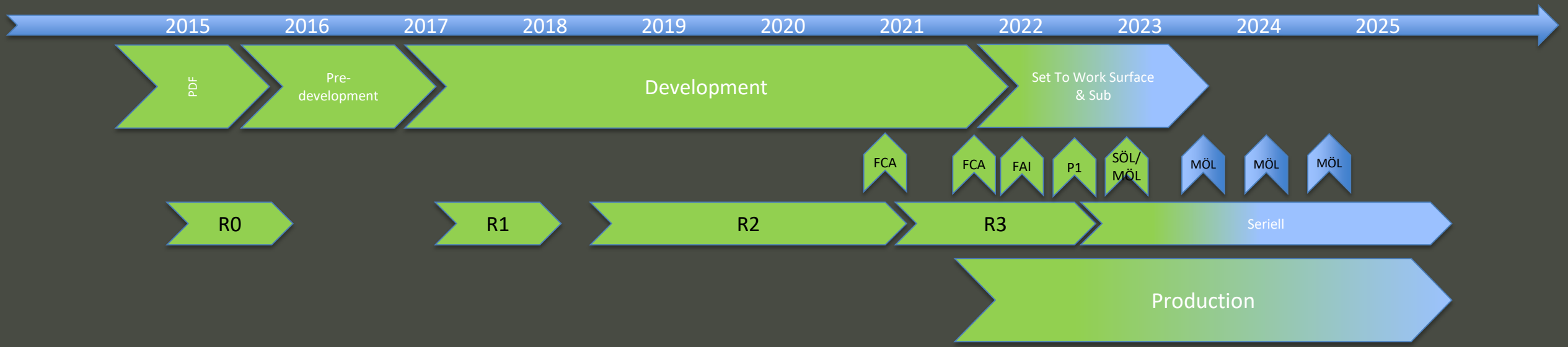
Project - Phases



Status

- Development closes
- Set To Work on platform
- Sea Acceptance Test is on going (plattforms)

R0 – Battery & Engine
R1 – Vehicle (Exercise, Electronic, Battery & Engine)
R2 – Vehicle (Homing, Exercise, Battery & Engin)
R3 – Vehicle (Full for environmental testing)
FCA – Final Configuration Audit
FAI – First Article Inspection

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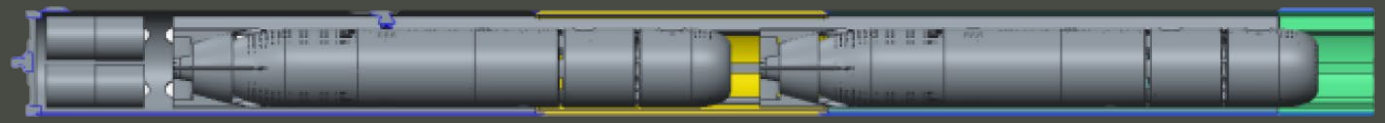
Torpedsystem 47 – Coming phases

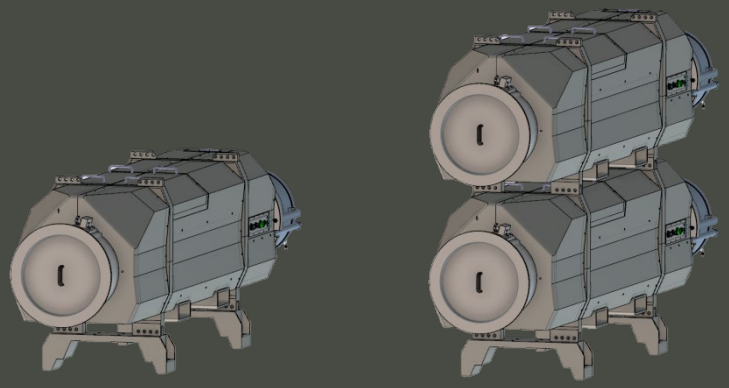
Helo

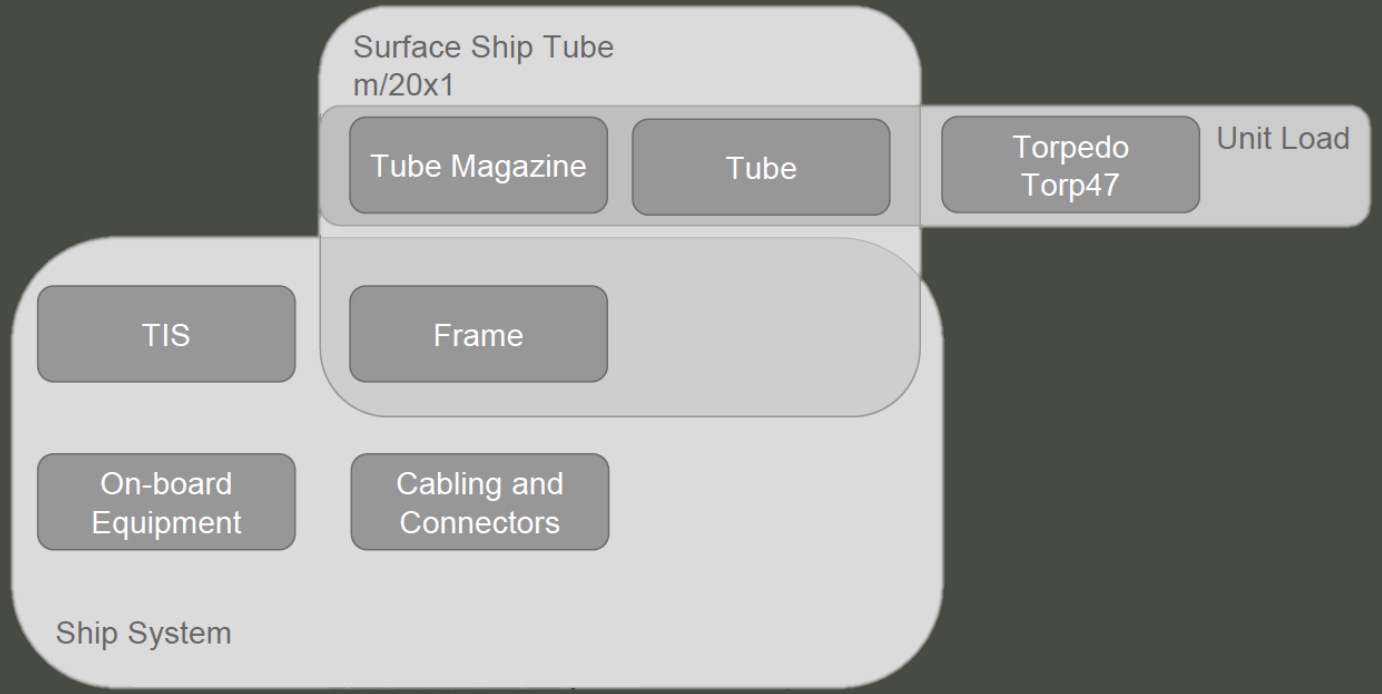
Integration on Submarine Blekinge (53 cm tub => 40 cm)



New Surface Tubes

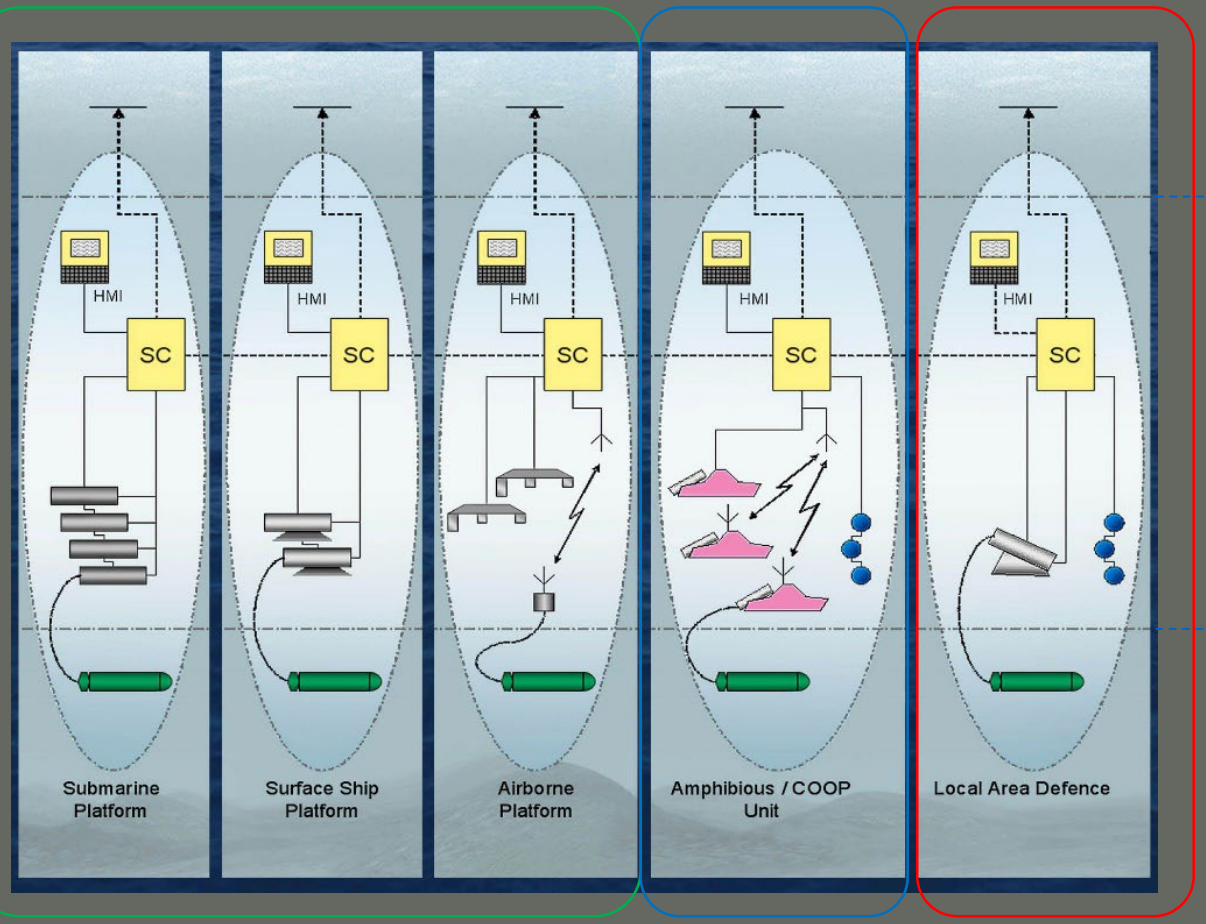
- Replace todays tub m/8502
- Unit load





Launching plattforms – COOP

(Craft Of OPportunity)



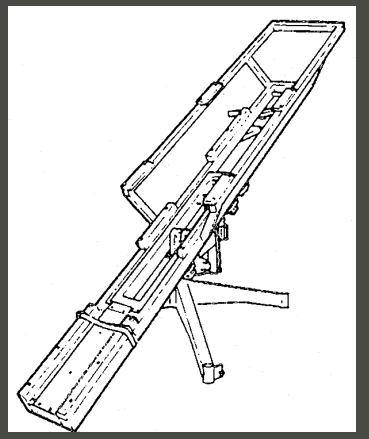
Platform/ NCW Layer

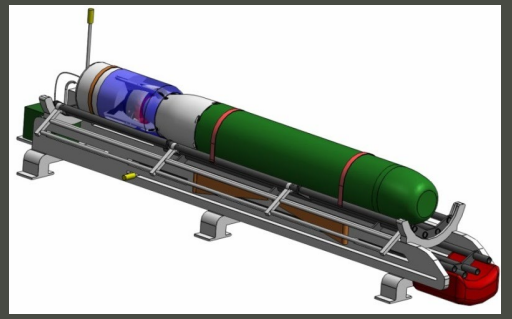
Controller Layer

SC = System Controller (TIU)

Vehicle Layer

Primary
Additional
Future





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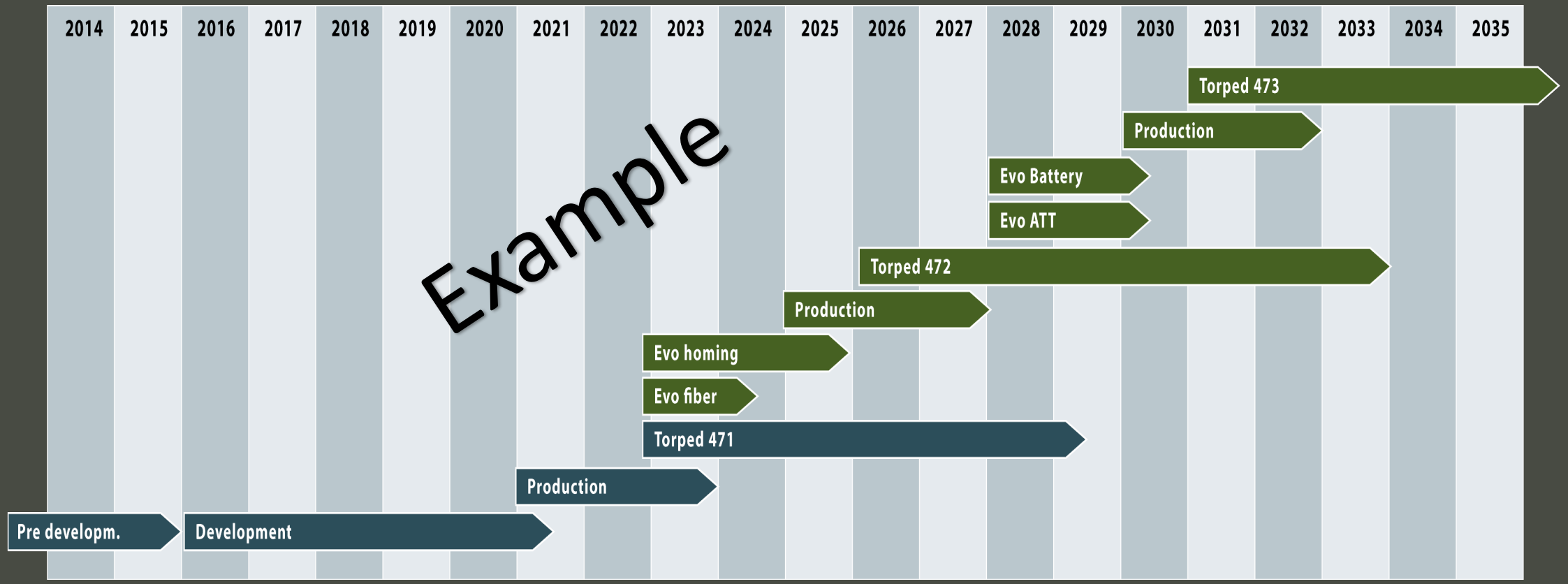
Design to cost

Strategy for evolutionary development • COTS • Life Cycle (LCC)



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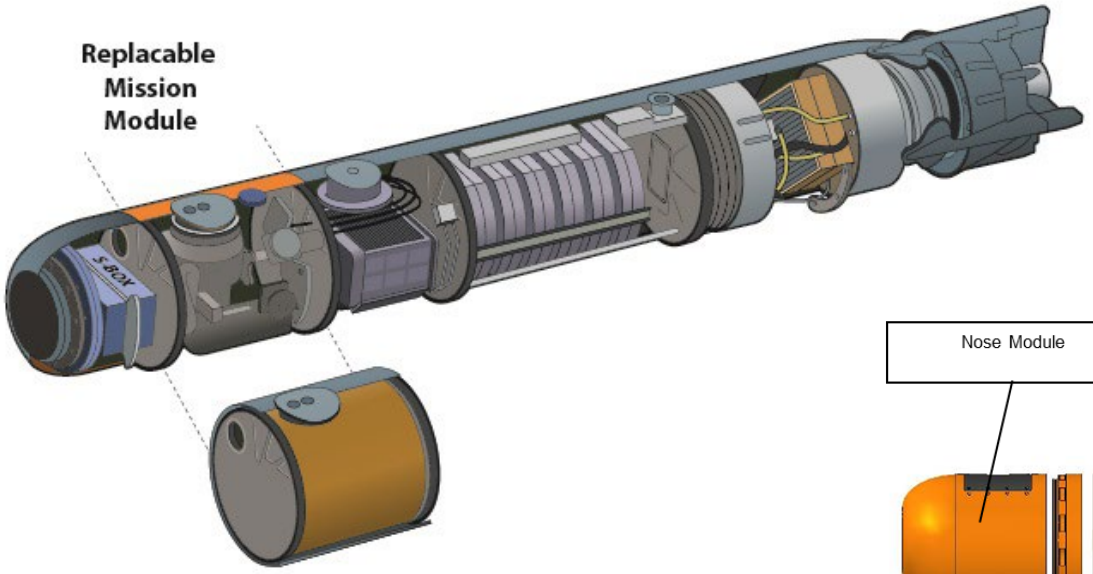
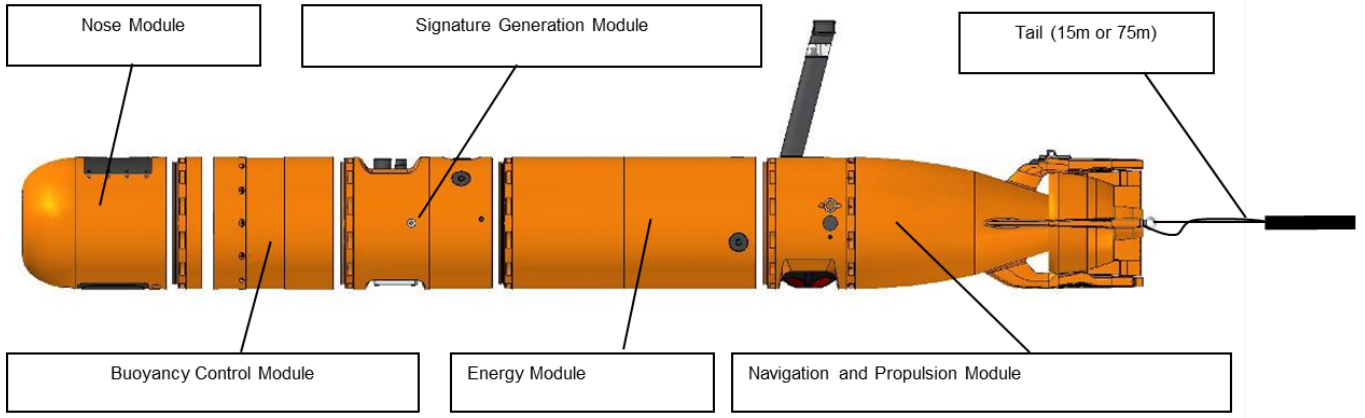
Modular design - Family

Torped 47



Torped 62

AUV62-AT



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Technical Platform

Handles short technical lifetime of components as it allows for “*Rapid COTS insertion*"
Allows upgrades and development during lifecycle
Recyclability between different products – “Common shared Components & Subsystems”

“It should also be said that the technical platform is more than hardware. It's logistics, software, knowledge and skills”

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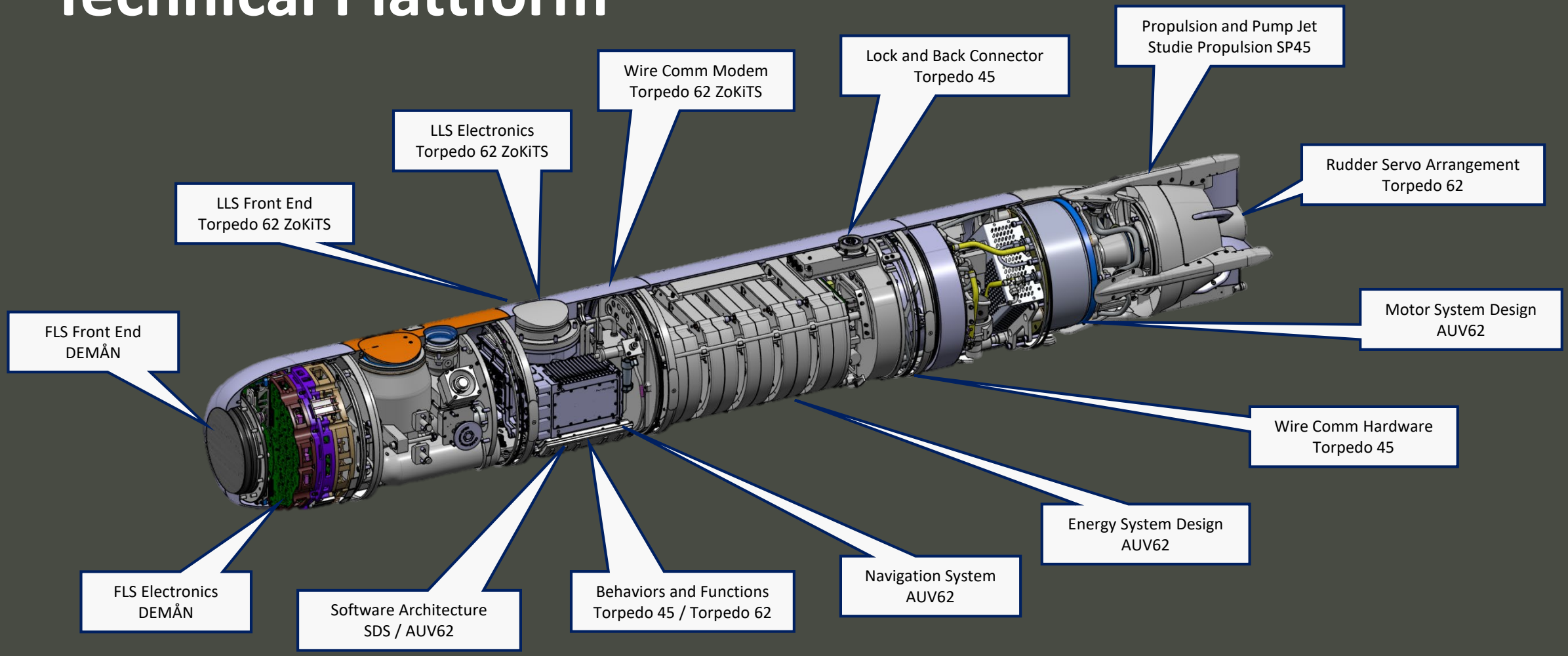
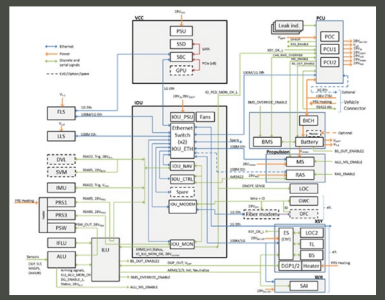
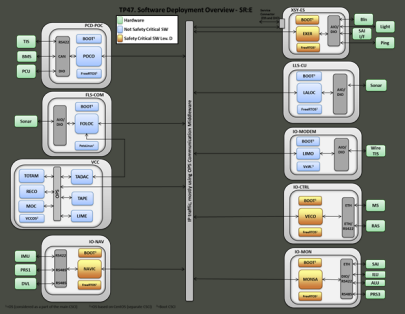
Technical Plattform



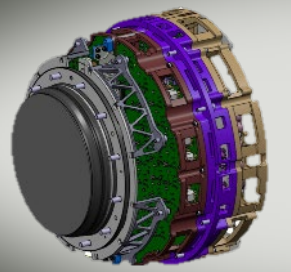
Technical Platform

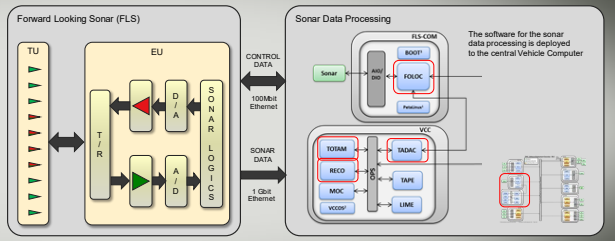
Overall Torpedo Architectures (HW and SW)



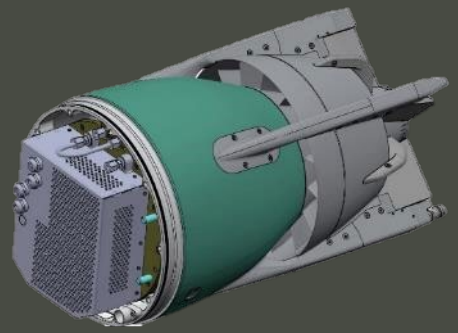


Homing System (MS5)



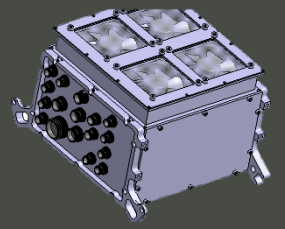


Propulsion System Modelling and Design

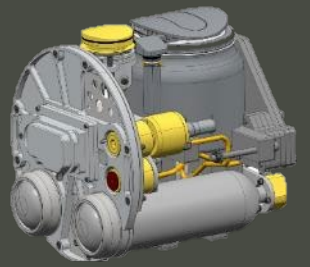


Various System Components and Solutions

IMU



IO-Unit



Recovery System

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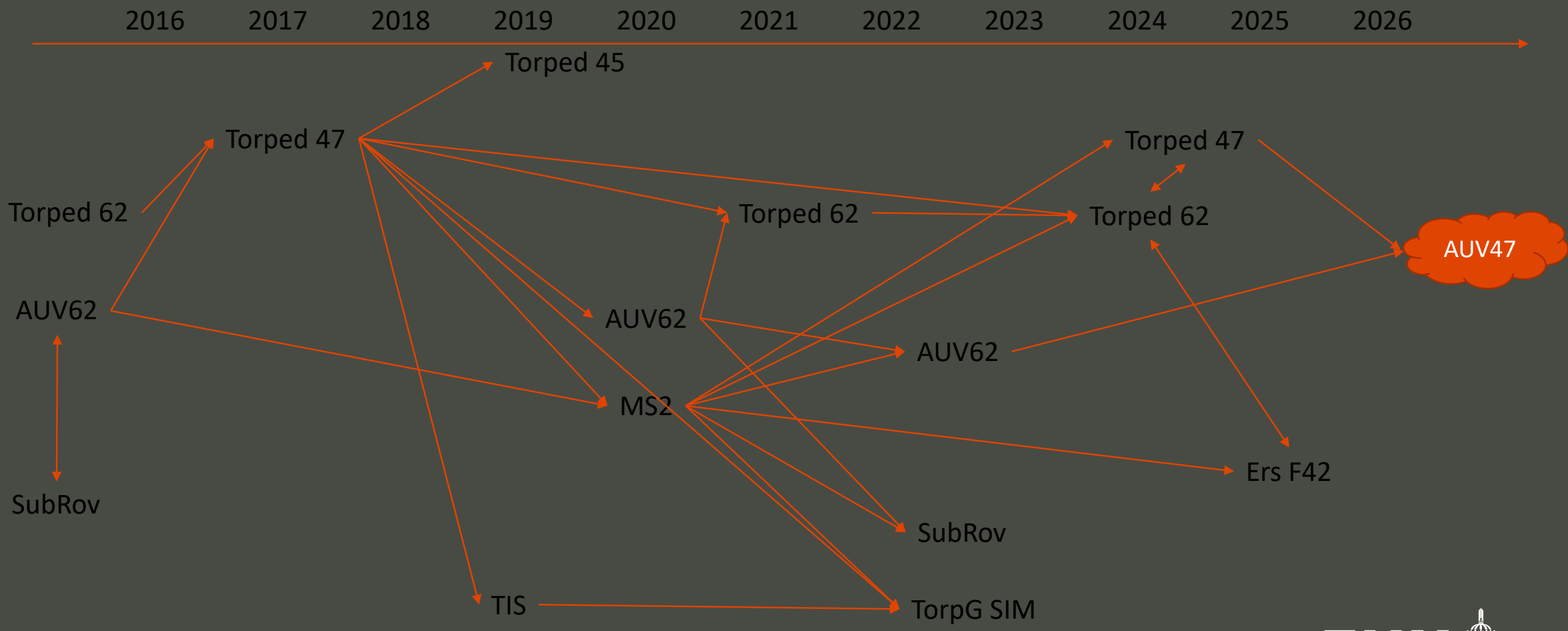
Modular design – Family – Techical plattform



Torpedo cooperation between Sweden & Finland

First deliverance to SwAf

20 Dec 2022.

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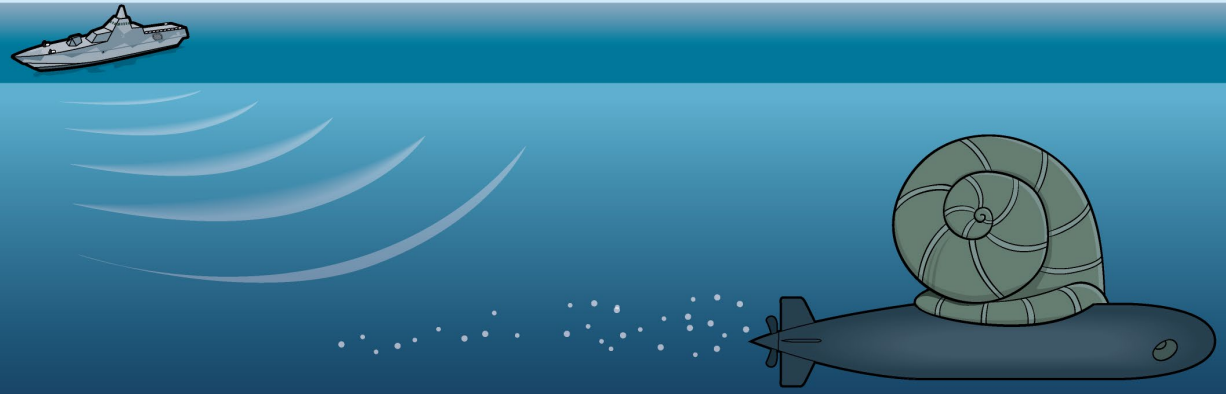
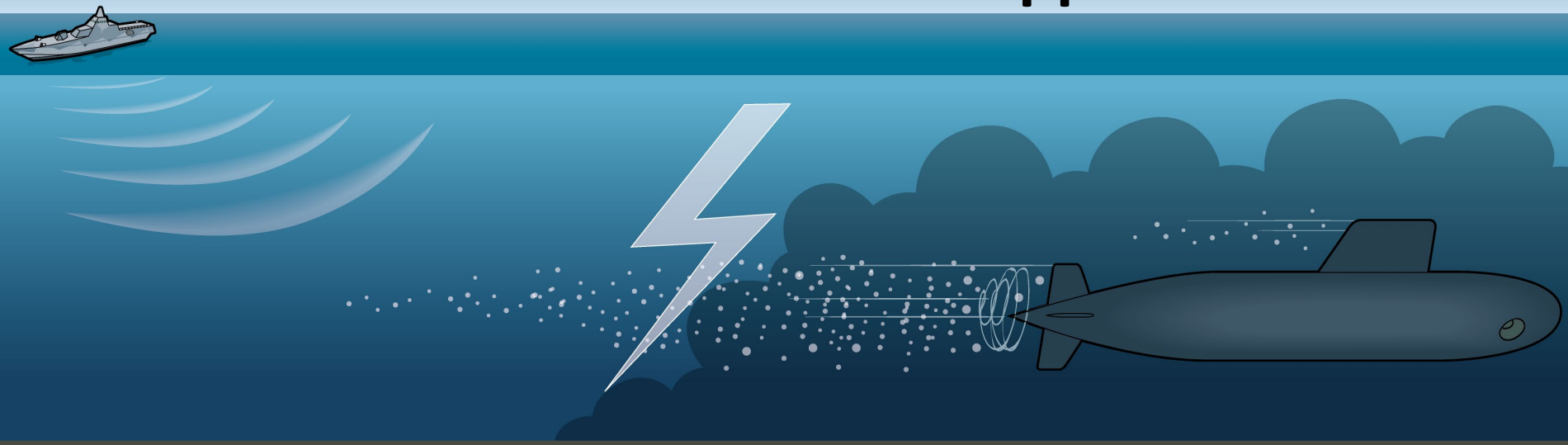
The opportunity to a successful ASW attack comes like a snail…



…and disappears like a flash



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FÖRSVARETS MATERIELVERK