New Generation Artillery Proximity Sensor Application to Naval Fuzes

Max Perrin

52nd Annual Fuze Conference
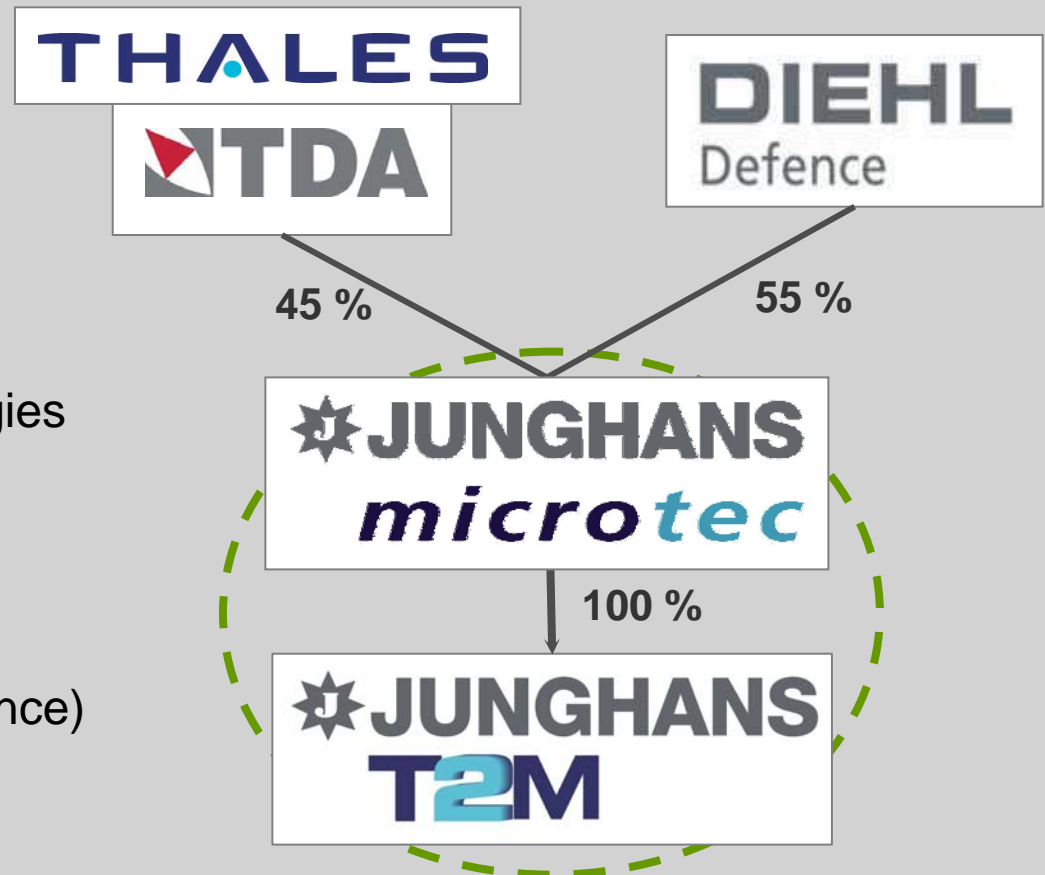**May 13 – 15, 2008 - Sparks, NV**
"Smart Fuzing – Adding Intelligence To Fuzing Solutions"

OUTLINE

- Company Presentation

- Smart Fuzing / Target Detection Issues

- Proximity Fuzing Background

- New Generation Proximity Sensor

- Use in FRAPPE Multifunction Fuze

- Use in Other Fuze Products

- Application to Naval Fuzes

A JUNGHANS Microtec GmbH / Diehl and Thales Company

- **A global leader in the field of ammunition fuzes and S&A devices**

  - Full range of products

  - Key competences in fuzing technologies, ammunition electronics and micro-technologies

  - Located in :
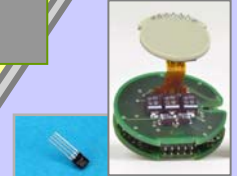   - Seedorf (Germany)
    - La-Ferté-Saint-Aubin (France)

THALES
TDA

DIEHL
Defence

45 %   55 %

☼ JUNGHANS
microtec

100 %

☼ JUNGHANS
T2M

Product Range and Competences

Artillery

Mortar

Air Bomb

Missile SAD and ESAD

Sensors Signal Processing

Micro-Technologies Miniaturized Systems

COMPETENCES

EFI / ESAD Technology

Medium Caliber and Direct Fire

Infantry Grenade

Mission Management

Hard Target Smart Fuzing

Safety Design

Energetic Materials dynTEC

AT, A/G, G/G Rockets

A JUNGHANS Microtec GmbH / Diehl and Thales Company
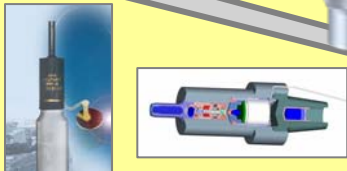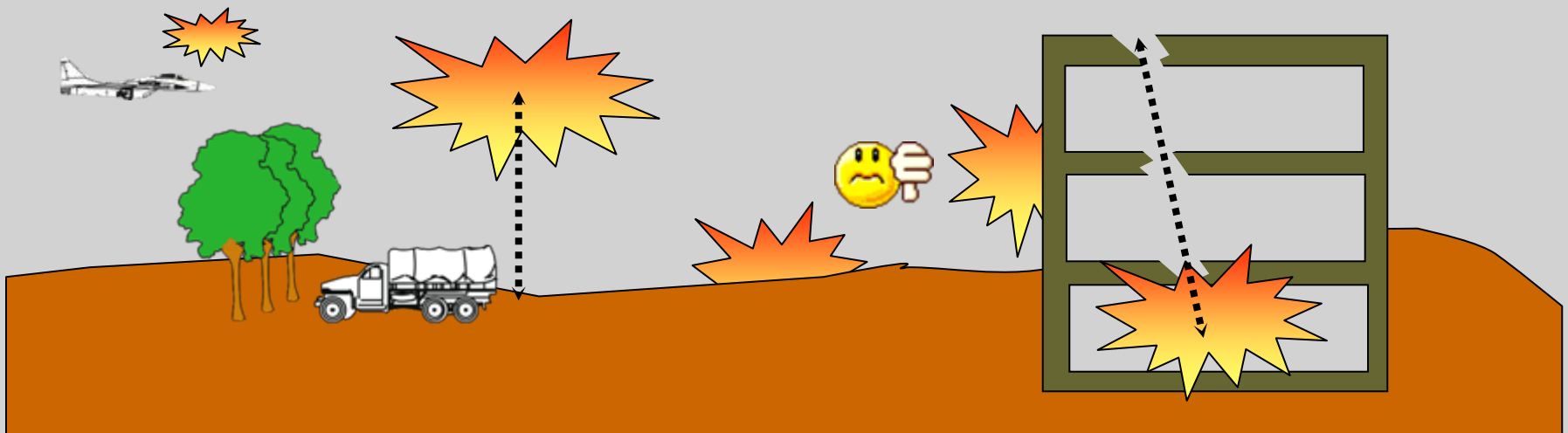
- Objective: Optimize terminal effect on target whatever the operational configuration is

- Solutions: Use sensors and signal processing to initiate the munition warhead on target at the optimum time
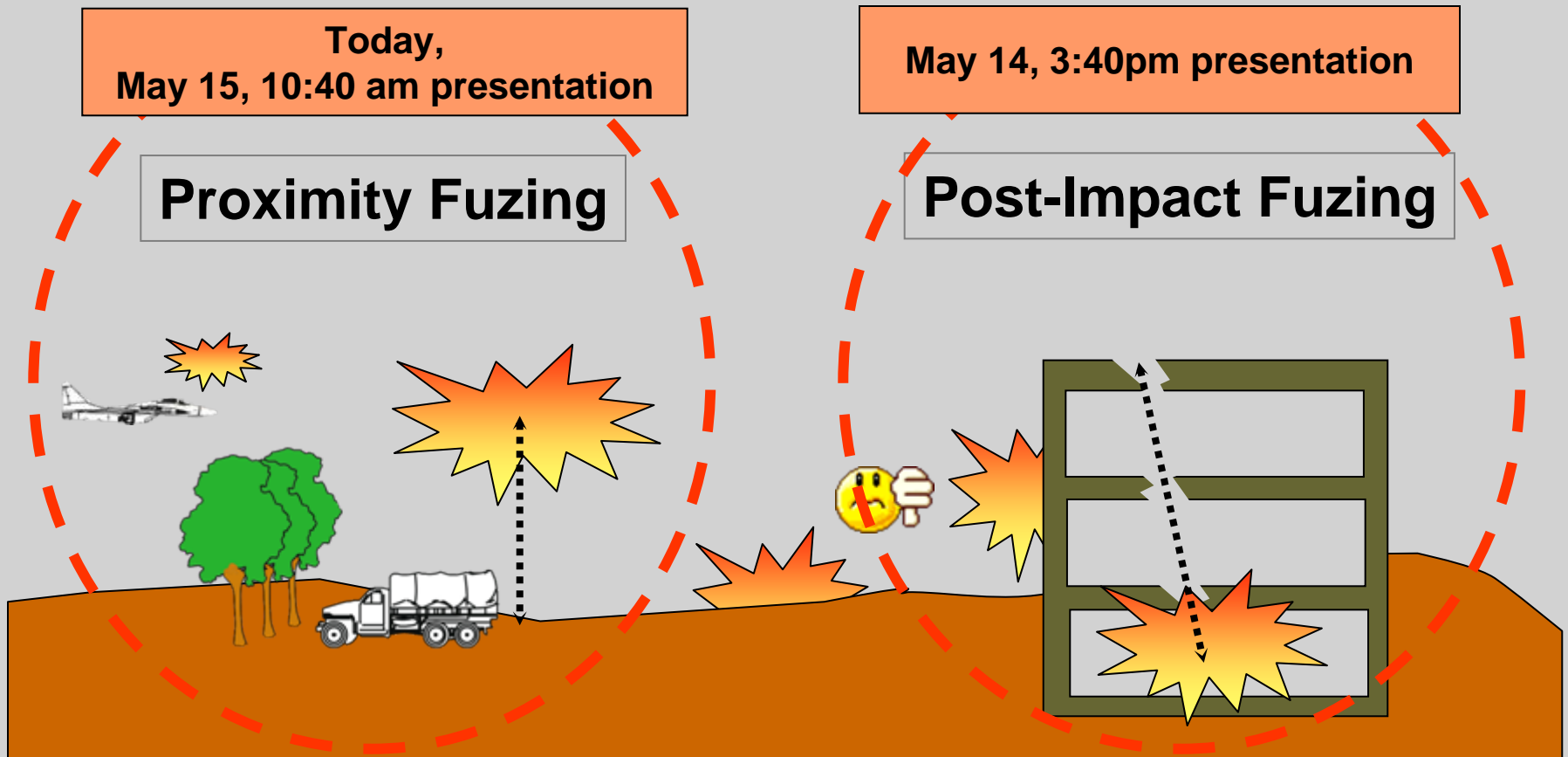
Proximity Fuzing

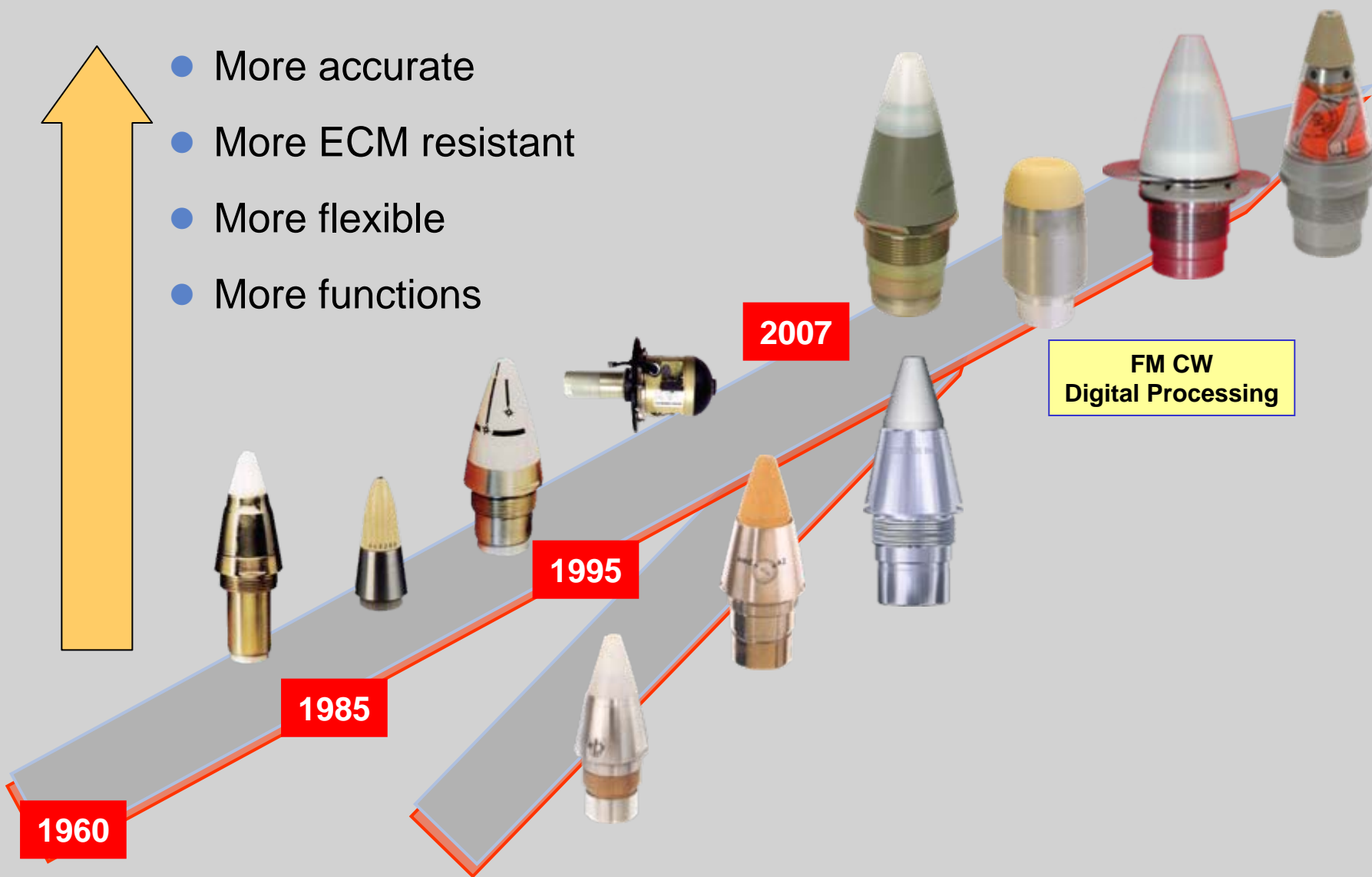**Post-Impact Fuzing**

- Objective: Optimize terminal effect

JUNGHANS provides effective solutions for both applications

Today, May 15, 10:40 am presentation	May 14, 3:40pm presentation
Proximity Fuzing	**Post-Impact Fuzing**

- More accurate
- More ECM resistant
- More flexible
- More functions

2007

**FM CW
Digital Processing**

1995

1985

1960

A JUNGHANS Microtec GmbH / Diehl and Thales Company

New Generation Proximity Sensor

- JUNGHANS T2M has designed and engineered a new state-of-the-art proximity sensor for the new generation artillery multifunction fuze *FRAPPE*.

  - FM-CW Microwave Radar Sensor

  - Full Digital Signal Processing

A JUNGHANS Microtec GmbH / Diehl and Thales Company
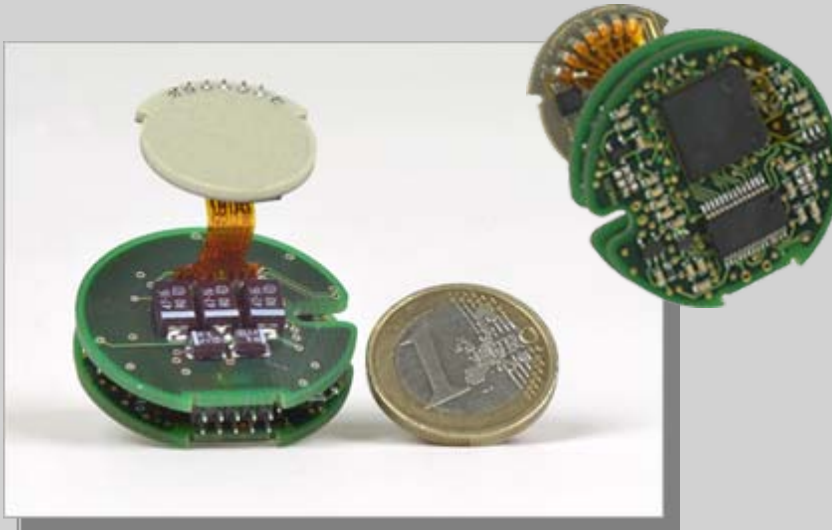
- Achieves better <u>detection and discrimination</u> performances

(1) <u>Better detection accuracy</u>
  - HOB accuracy whatever the terrain configuration is
 - Possibility to select various HOB

(2) <u>Better resistance</u> to jamming and electromagnetic countermeasures

thanks to smart digital signal processing:
  - Spectrum analysis
    - Distance analysis (height of burst)
    - + Doppler analysis
  - Extraction of trajectory parameters
  - Analysis of the coherence of the data vs time
    - Tracking of the projectile height (distance) evolution

HOB Measurement – Sensor Signal Processing

Spectrum Analysis

FRAPPE fuze fitted with embedded data recorder

h

A JUNGHANS Microtec GmbH / Diehl and Thales Company
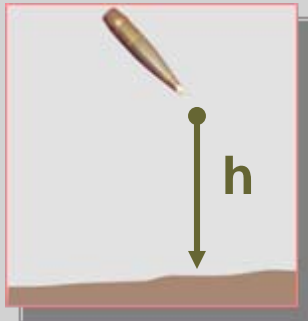
Application on FRAPPE Multifunction Fuze

- **New Generation Multifunction Fuze**

  - For new 155mm/52 calibre munitions

  - Compliant with IM requirements

  - Compliant with modern gun environments

  - Provide better operational flexibility and better fuzing performances
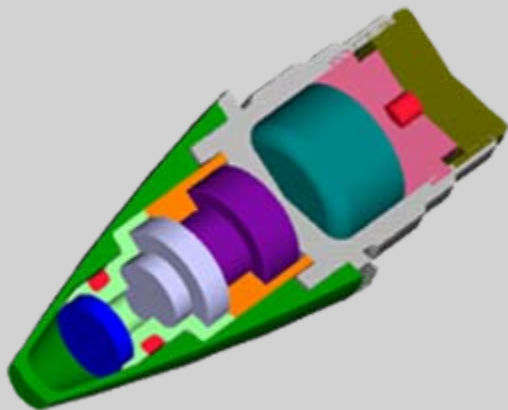
- **Operating modes**

  - **Proximity**
    Programmable HOB and inhibition time

  - **Post-Impact Delay**
    Programmable delay

  - **Point detonating**

  - **Time**

  - **Inductive setting** according to STANAG 4369 / AOP22

A JUNGHANS Microtec GmbH / Diehl and Thales Company

FRAPPE Fuze – Qualification Test Results

- More than 450 FRAPPE fuzes fired in all weapon and environment conditions.

- Qualification tests completed: December 2007

- 150 firings : 100% successfull – No failure

- Program Status
    - Initial Production

Ordered by the French Army

A JUNGHANS Microtec GmbH / Diehl and Thales Company

Coup N°3 - M107PLT/Frappe LHESA: 8,57m

A JUNGHANS Microtec GmbH / Diehl and Thales Company

Application on SPACIDO Fuze

- SPACIDO Course Correction Fuze
    - Artillery 1D Course Correction System
    - Trajectory monitoring with muzzle velocity radar
    - Correction signal sent by the radar to the fuze
    - Course correction by air brake deployment
    - GPS independent

- SPACIDO Fuze integrates
    - FRAPPE Sensor and subassemblies
    - Air Brake device
    - Reception antenna and electronics

- Programme status
    - Validation firings (2007)
    - Full Development Phase
    - ISD 2011

In cooperation with neXTer MUNITIONS

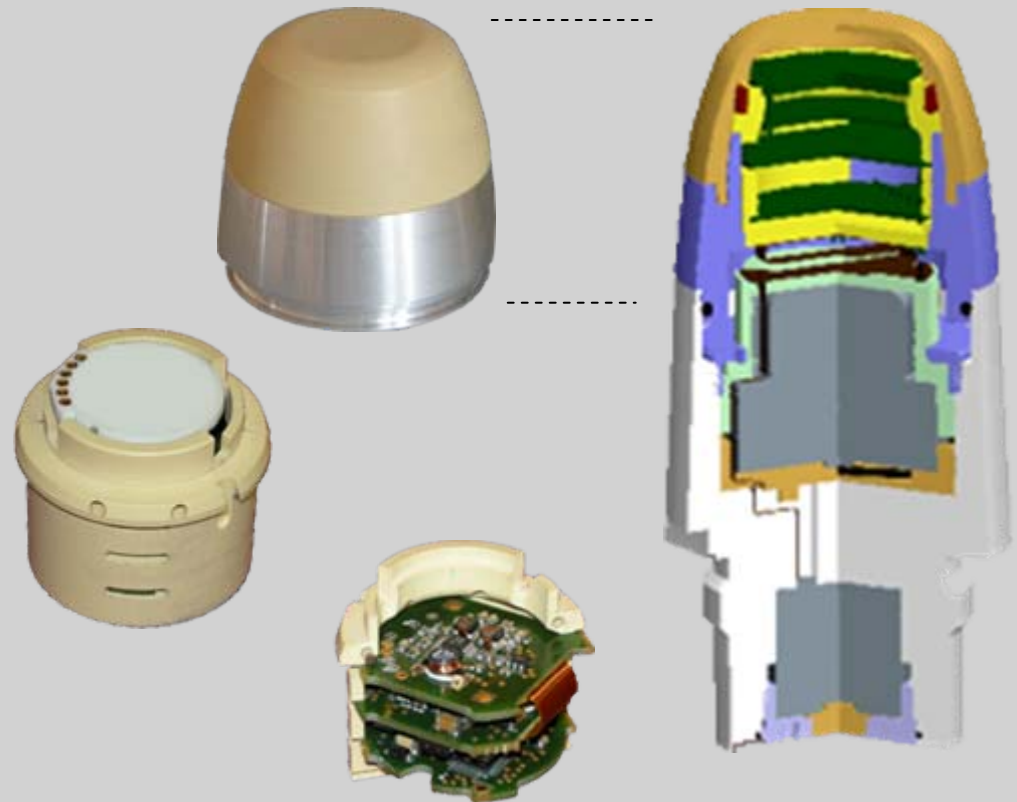A JUNGHANS Microtec GmbH / Diehl and Thales Company

- New Generation Mortar Multifunction Fuze under development by JUNGHANS Microtec for German Army (BWB)

- Operating Modes
  - **Proximity**
    Programmable HOB
  - **Post-Impact Delay**
    Programmable delay
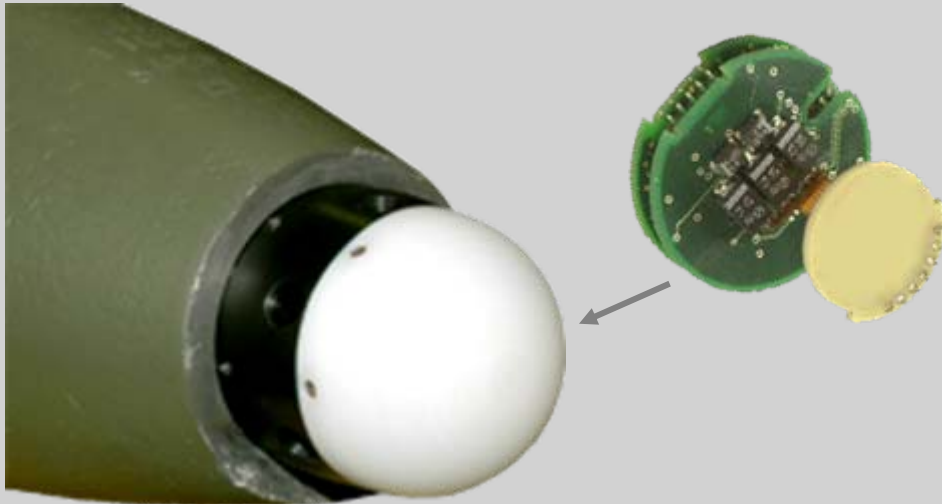 - **Point detonating**
  - **Time**

- Program Status
  - Full Development Phase
  - Qualification End 2009

Sensor Application: Air Bomb Proximity Sensor
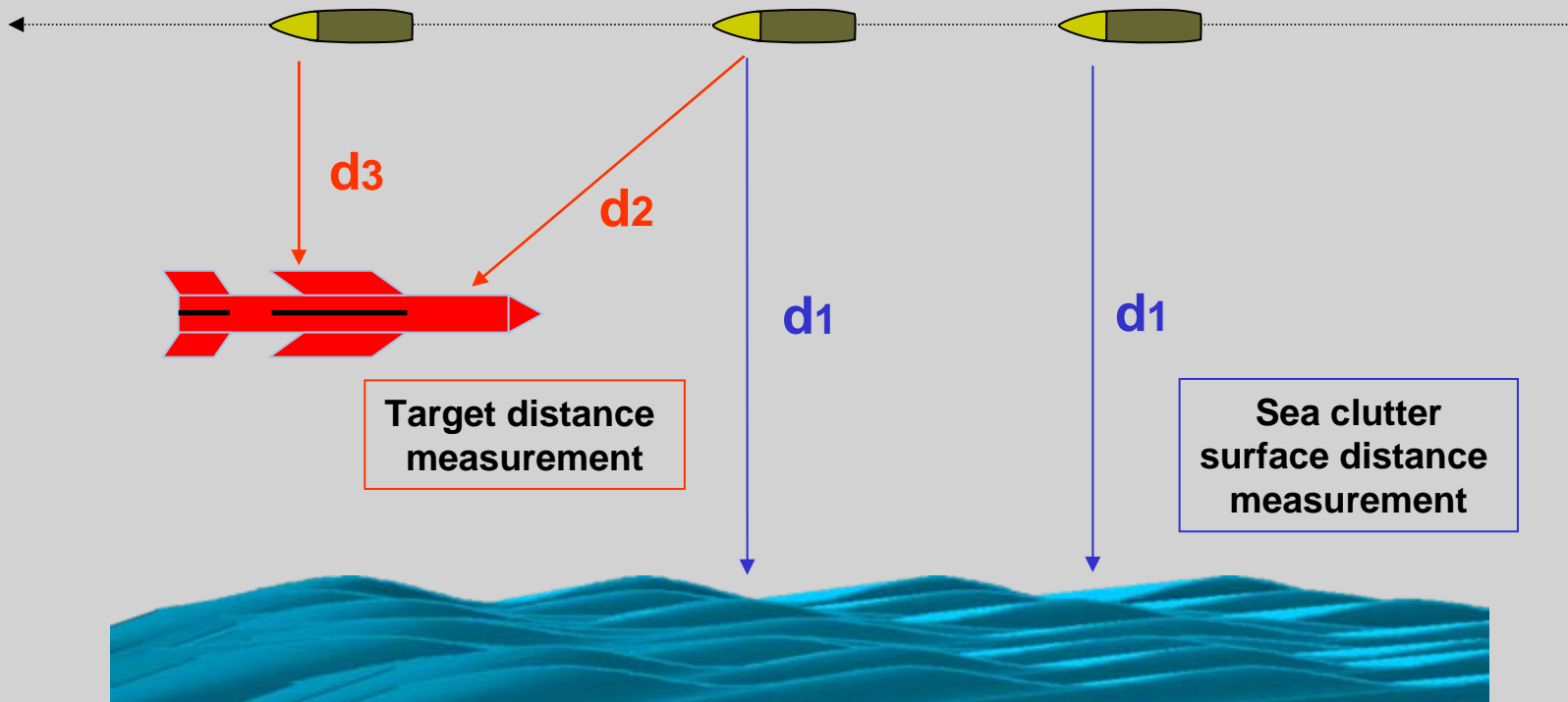
- Nose prox demonstrated in flight

13:50:30.040 178

0.060 178

A JUNGHANS Microtec GmbH / Diehl and Thales Company

Naval Fuze Sensor Application

- **Purpose:**
  - Adapt the new generation FM-CW sensor to air target detection mission

- **Issue:**
  - Current sensor is designed for surface detection

- **Objectives:**
  - Keep current sensor hardware and architecture
  - Cope with:
    - Sea clutter disturbance
    - Target Radar Cross Section

  ➡ Implement specific signal processing software

A JUNGHANS Microtec GmbH / Diehl and Thales Company

Target / Clutter Discrimination

- FM-CW sensor actually measures object distances

➡ Makes possible discrimination between reflected signals: Range gated processing to isolate sea-clutter from valid targets

d3

d2

d1

d1

Target distance measurement

Sea clutter surface distance measurement

A JUNGHANS Microtec GmbH / Diehl and Thales Company

Sea-Skimmer Detection

Time / Trajectory

Target level / Distance Fuze - target

Missile target echo

Surface echoes

Actual trajectory and target recorded signals

A JUNGHANS Microtec GmbH / Diehl and Thales Company

Sea-Skimmer Detection

Time / Trajectory

Missile target echo

Target level / Distance Fuze - target
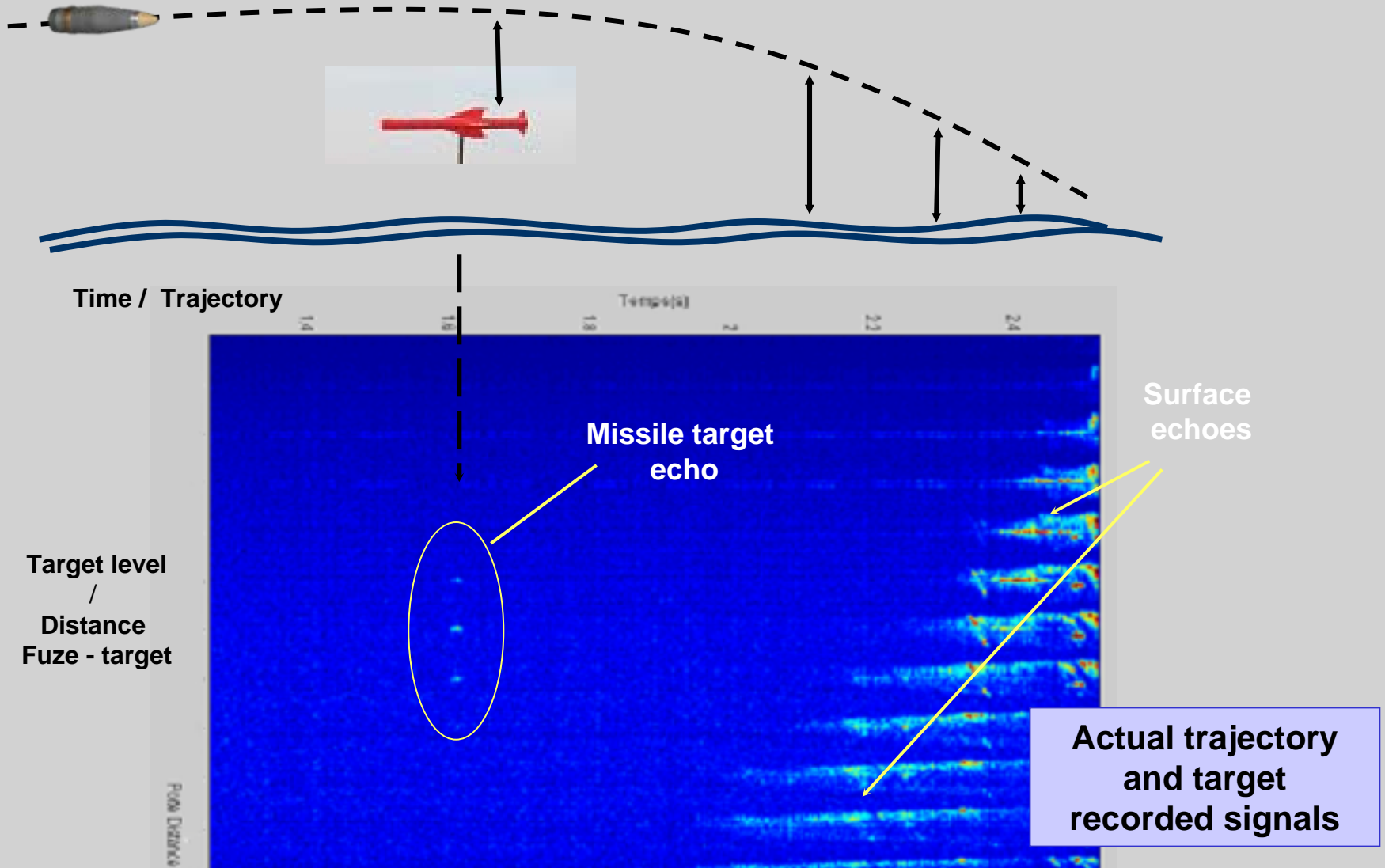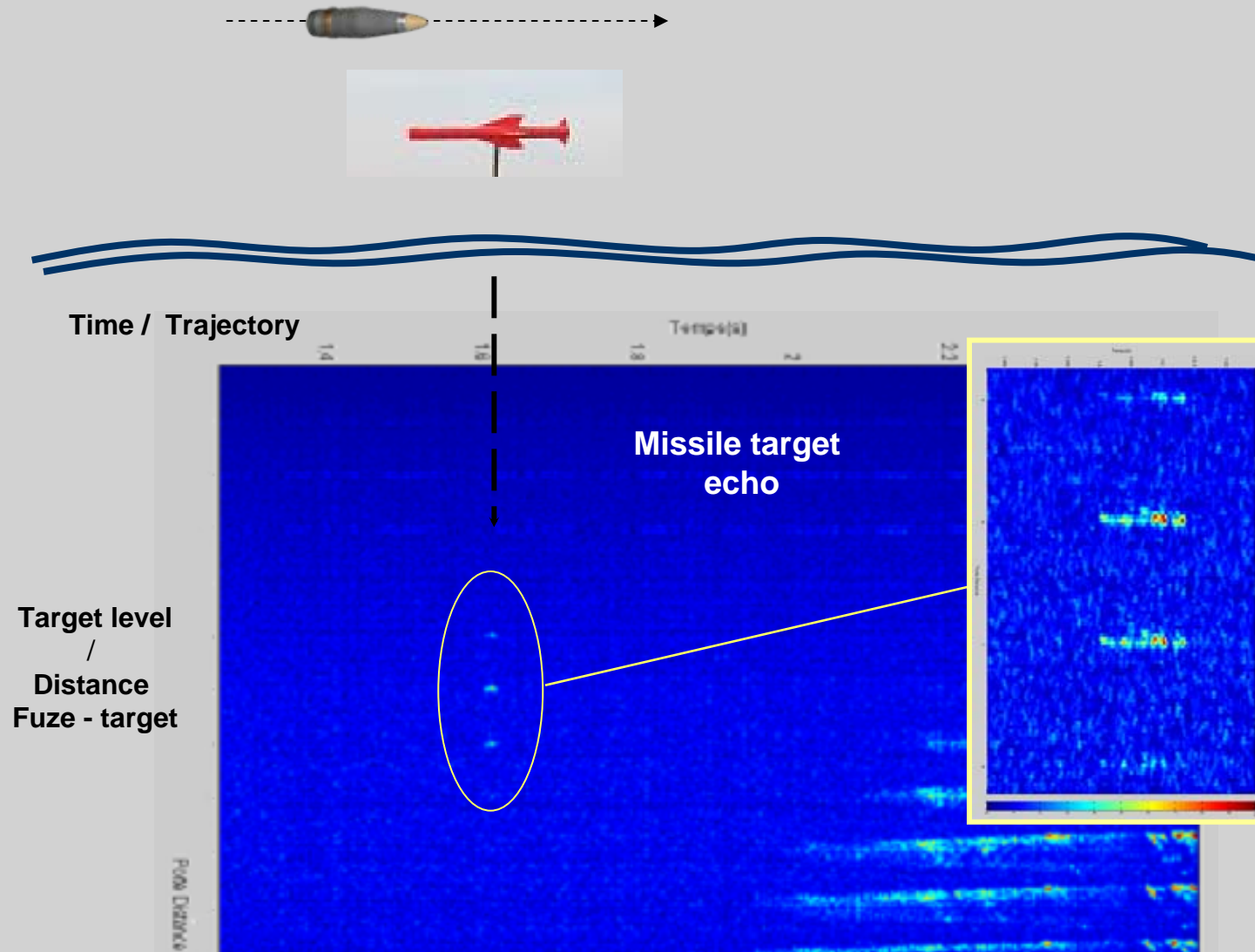
Smart Fuzing – Proximity Fuzing

● JUNGHANS new proximity sensor technology

⟹ Makes fuzes "smarter"

- More accurate on target
- More resistant to counter-measures
- More flexible to use

⟹ For better | Strike efficiency

Operational flexibility

"Smart Fuzing – Adding Intelligence To Fuzing Solutions"

A JUNGHANS Microtec GmbH / Diehl and Thales Company

New Generation Artillery Proximity Sensor Application to Naval Fuzes

Thank You

Max PERRIN
Chief Technical Officer

max.perrin@junghans-t2m.fr

Unterbergenweg 10
78655 Dunningen-Seedorf
Germany

Route d'Ardon
45240 La-Ferté-Saint-Aubin
France

A JUNGHANS Microtec GmbH / Diehl and Thales Company