NCC NUREMBERG, GERMANY
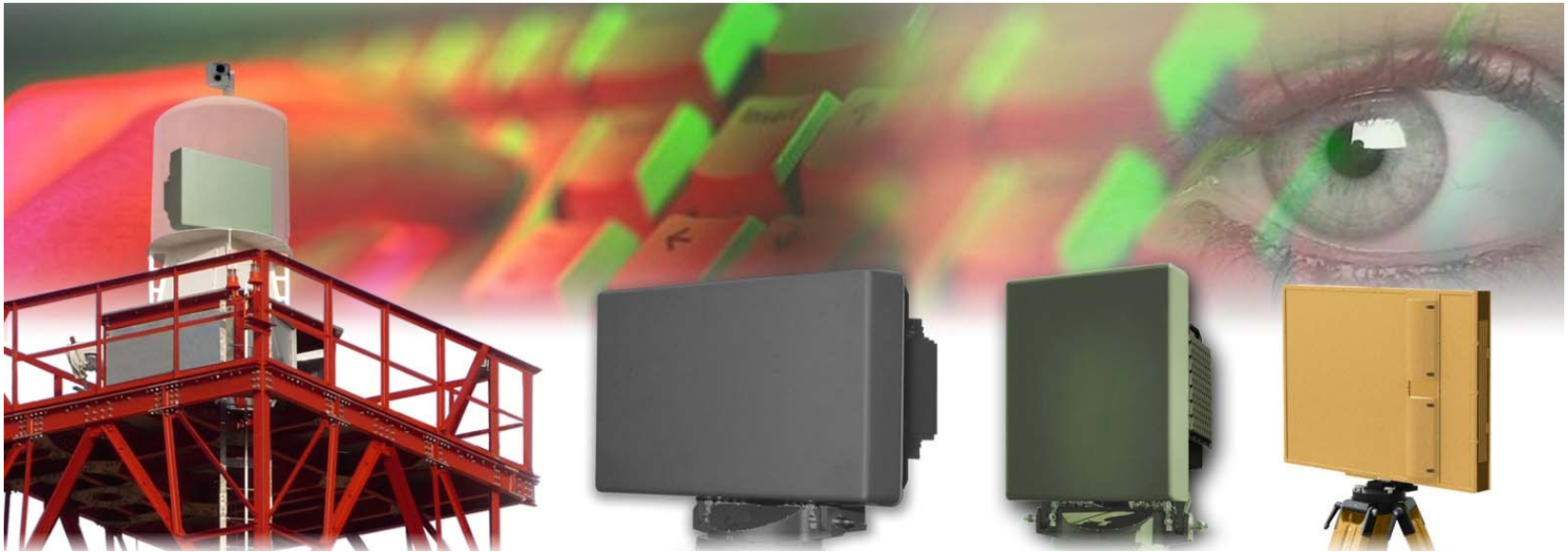6-11 OCTOBER 2013

EUROPEAN MICROWAVE WEEK

MEET EXPERTS MAKE FRIENDS

EXHIBITION HOURS:
TUE 9.30-17.30   WED 9.30-17.30   THU 9.30-16.30

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AN EADS COMPANY

High Performance X-Band E-Scan Radar for Security Application

Nürnberg, 09.10.2013
Andreas Strecker
Chief Engineer Radar

SPEXER™ Radars – Security you can rely on

- **CASSIDIAN started in 2008 with this radar product family**
- **The presentation covers the way of family realisation**
    - **Task, Idea and concept**
    - **The two different ways of realisation**
    - **Experience and lessons learnt**
    - **Status of today and way ahead**

Main radar product family tasks
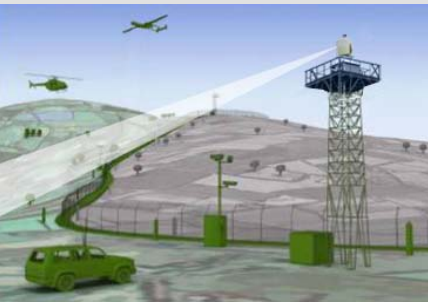
Border surveillance
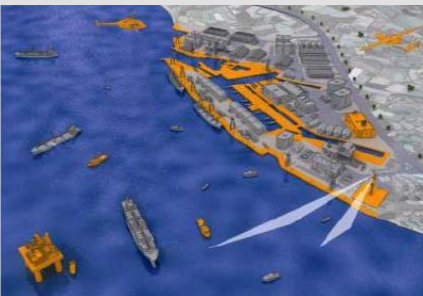
Coastal surveillance

Main Task/requirement:

Detection and <u>tracking</u> of threats

• Persons

• Small vehicles

• Small low flying airplanes like UAVs

• Small boats

• Swimmer

Operation in different clutter conditions

• Land surveillance

• Coastal surveillance with same target size on land and on sea

Large System integrator task

• Family as basis for cost efficient system

• Same interface for the complete family

• Same Human machine interface

• Flexible operation: fix and mobile

• Family members optimized to different tasks

  • In cost to different tasks like range

  • In size and weight e.g. mobile

  • Long life cycle

Infrastructure/Perimeter surveillance

Camp surveillance
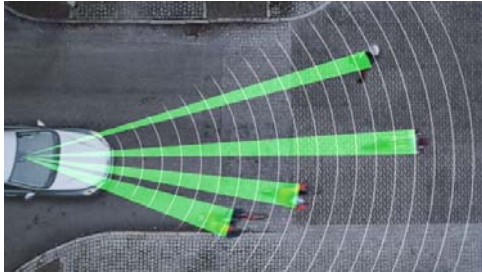
Two different ways of realisation

SPEXER 2000

Pedestrian 20km

Nucleus: Military project
Pulse Doppler-Radar

Nucleus: Short range radar
FMCW-Radar

Nucleus-Design:
- **Military qualification**
- **Long life cycle**
- **Expensive**
- **High performance**

SPEXER 2000
Coastal

Pedestrian 20km
Swimmer 2km

Nucleus-Design:
- **Re-use of commercial development**
- **Cheap HW, SW based improvements**
- **Medium life cycle design**

SPEXER 1500

Pedestrian 15km

SPEXER 500

SPEXER 1000

SPEXER 2000 3D
TRSS

Pedestrian 20km
Swimmer
Moving plattform

Pedestrian 5km

Pedestrian 8km

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Common Radar family features
Electronic Scan Antenna

shift every 0.33 s → 120° in 1.3 s

simultaneously processed beams

simultaneously processed beams

simultaneously processed beams

simultaneously processed beams

40 km
30 km
20 km
10 km
0 km

Pulse Doppler radar
• Pencil beam operation TX and RX
• Multi-beam Operation
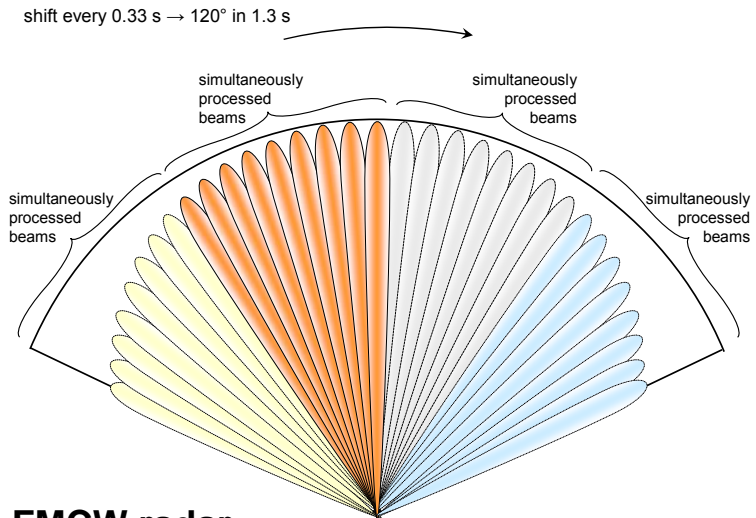
FMCW radar
• Broad transmit beam TX
• Digital beam forming on receive RX
• Multi-beam Operation

Common operational benefit and difference to the competition:
• Using Multibeam increases the Update rate
• Sector-Scan with constant target update rate in comparison to M-Scan radar
=> Despite use of Doppler High resolution for slow target detection high update rate
=> **Achievement of operational reliable useable Track While Scan**

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Common Radar family features Electronic Scan Antenna

No Doppler Widening of fix targets
- M-Scan radars widen the spectrum
- Widening defines the low speed performance
- Widening can shadow slowly targets

intensity

AESA does not affect natural clutter

M-Scan worsens clutter and hides slow, low-RCS target

rad. velocity

Common operational benefit and difference to the competition:
- No Doppler widening
- => Lower Doppler measurement capability
- => **Achievement of operational reliable useable slow target detection**
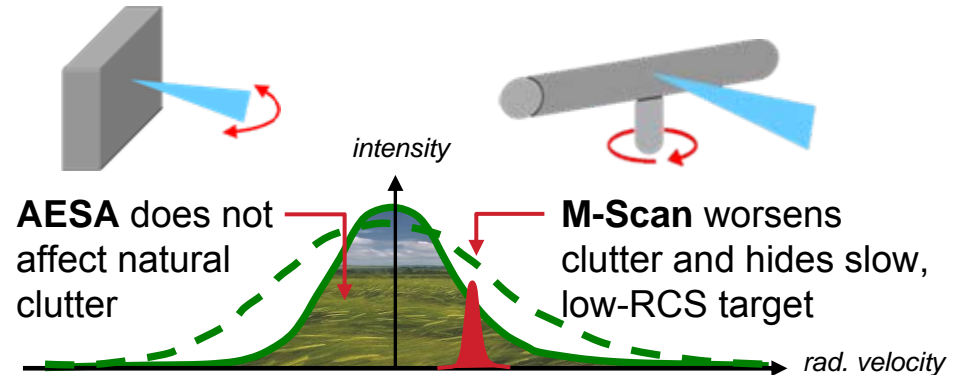
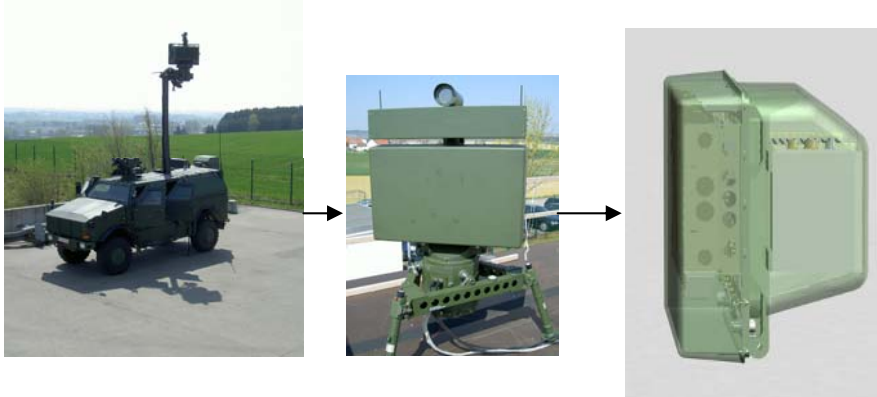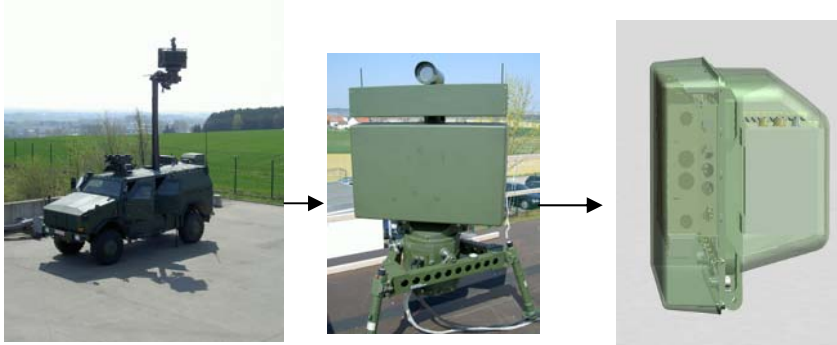# Two different ways of realisation Pulse Doppler radar Design

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Nucleus: Military project

SPEXER 2000

Pedestrian 20km

SPEXER 2000 Coastal

Pedestrian 20km Swimmer 2km

SPEXER 1500

Pedestrian 15km

Nucleus Design:
- **CASSIDIAN own defined architecture and design**
- **First Design already driven by the product idea**
  - **Modular design with standard interfaces**
  - **Design with growth potential e.g. Interfaces**
- **Architecture with autarc operational building blocks**
  - **Antenna Unit**
  - **Radio Frequency Unit / Radar processor**
  - **Pedestal with mechanical drives**

SPEXER 2000 3D TRSS

Pedestrian 20km Swimmer Moving plattform

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Two different ways of realisation Pulse Doppler radar derivatives

Nucleus: Military project

SPEXER 2000

Pedestrian 20km

SPEXER 2000 Coastal

Pedestrian 20km Swimmer 2km

SPEXER 1500

Pedestrian 15km

SPEXER 2000 3D TRSS

Pedestrian 20km Swimmer Moving plattform

- Requirements of the nucleus project
  - Partially oversized for security applications
  - Core features fit to security applications
    - Subclutter visibility, small and slowly target detection
    - Range performance
    - Multi beam operation

=> Consequences:
- Architecture stable since the beginning, many product improvements can be realised by SW e.g. swimmer track generation
- Easy reduction of oversized expensive features
- Product variances can be realised by local changes
  => efficient adaptations with low risc e.g. smaller antenna, pedestal change, 3D version by change of radiating element

Market position: Highest performance family but not cheap

Two different ways of realisation FMCW radar Design

Nucleus: Short range, Automotive radar
FMCW-Radar

Nucleus idea:
- **Re-use of external know how on low cost short range radar development technology for realisation of security radar**
  - **Use of cheap HW**
  - **Focus on SW based correction of cheap HW limitations**

SPEXER 500

SPEXER 1000

Pedestrian 5km

Pedestrian 8km

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Two different ways of realisation FMCW radar Design Experience

- **Different development culture in the different industries**
    - **Requirement tracing or fitting documentation**
    - **Architecture design philosophy different**
        - **Short range low cost <-> medium range long life cycle**
        - **Several 10m -> several km demand different HW design**
        - **Flexibility for additional tasks**
    - **SW design and documentation for long life cycle handling**
- **=> Consequences:**
    - **Many stepwise adaptations**
    - **Limitations through inflexible design**
        - **Goals not achievable due to architecture limitations**
        - **Difficult development planning with unpredictable risks**
    - **=> Big gap between planned and necessary efforts and time**
- **Market position:**
- **CASSIDIAN goal finally achieved as additional radar family member**
- **Medium performance, but cheap**

Nucleus:short range radar
FMCW-Radar
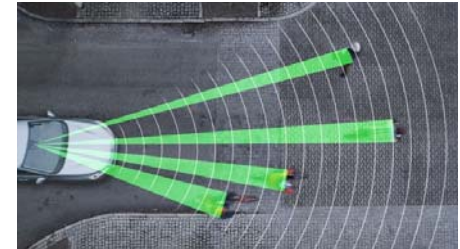
SPEXER 500

Pedestrian 5km

SPEXER 1000

Pedestrian 8km

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Lessons learnt

- **Handling of new projects: Requirements engineering with 3 categories**
    - **Requirement fits to the existing product requirements**
    - **Requirement can only be fulfilled with a project specific separate solution**
    - **Requirement interesting for the family and added to core requirements**

- **Handling of new developments**
    - **Architecture untouchable**
    - **Interface adaptations have to be compatible to the already delivered solutions**
    - **New functionalities/algorithms have to be realised in a way that delivered systems can be upgraded**
    - **New HW like Radar processor have to re-use existing interfaces and housing**

- **Restrictions/product discipline sound very limiting, but have the benefit that new projects can be planned**
    - **Precise as performance of re-used radar HW/SW is known exactly**
    - **With low risk**
    - **In short time as basis is available**

- **The core product team has a deep common technical understanding of the product**
- **The customer questions are used for the strategic acting of this core team for the design of the next improvements**
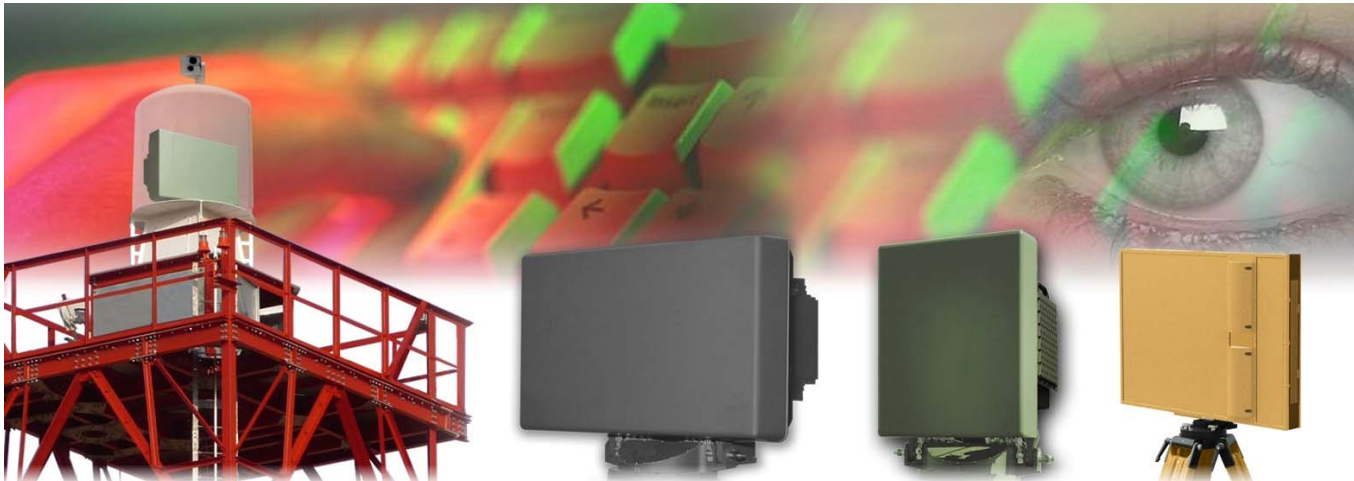
CASSIDIAN can offer with the SPEXER^{TM} Radars a product family
- **Family members operational with the same Human Machine Interface**
- **Similar interface for network operation**
- **Different members available for different tasks**
- **CASSIDIAN has a product for all security applications**

- **New family variances for new applications in development**

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Thank you

for your attention!

Questions ?