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# ROBIN Lite 3D FMCW Bird radar: Revolutionizing airport birdstrike prevention

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# ROBIN Lite 3D FMCW Bird radar

Revolutionizing airport birdstrike prevention

**TNO** | Kennis voor zaken



Addy Borst

# The avian radar arena



Once there were only 2 vendors of airport bird radars, but....

## A new kid in town: ROBIN Lite 3D FMCW avian radar

- Not as beautiful as this senator
- ....but at least as powerful
- You do not hear us saying that we have the best avian radar (we do think so)
- It is up to you to decide

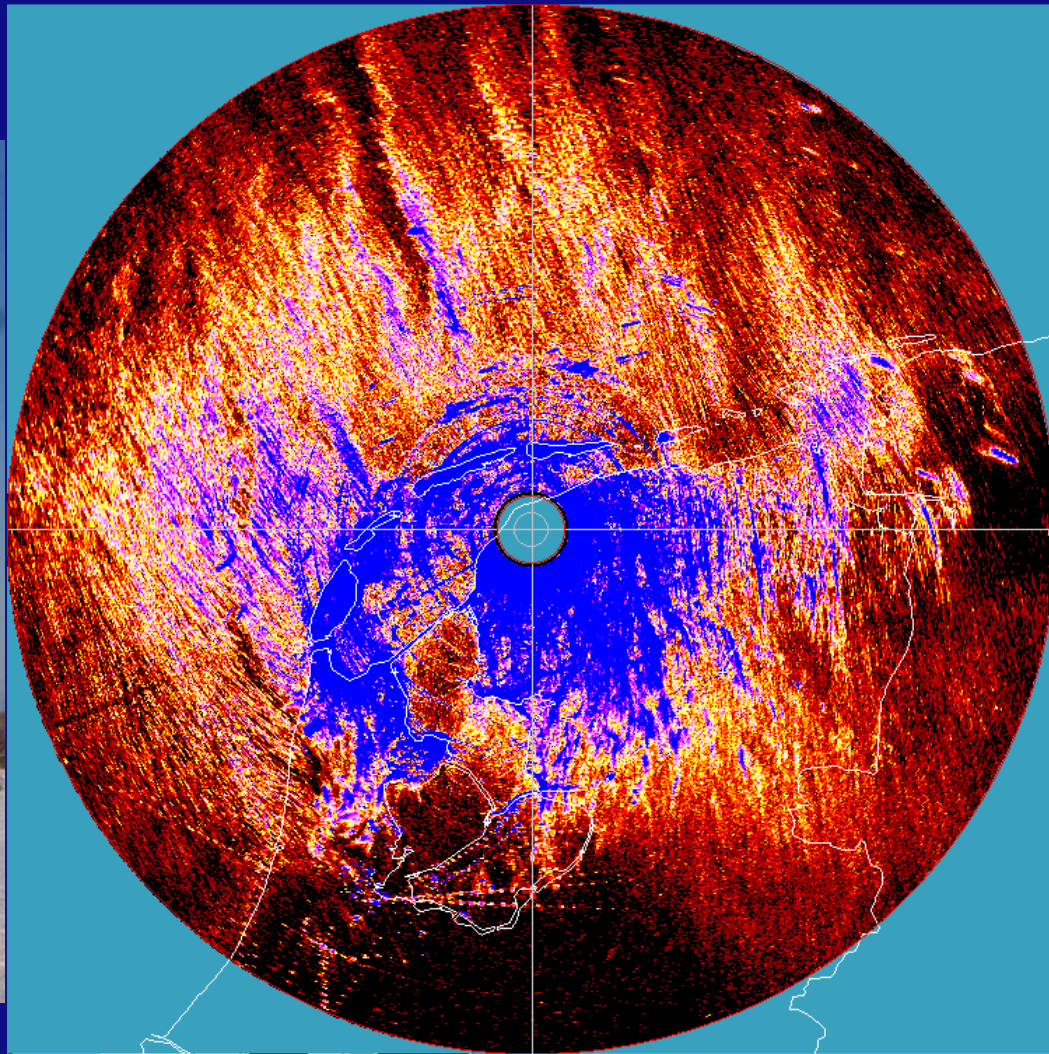


# Our roots in radar technology

- TNO is a 4500 employee R&D institute in the Netherlands
- Radar research since 1938
- Excellent international position in radar technology R&D
- info: [www.tno.nl](http://www.tno.nl)

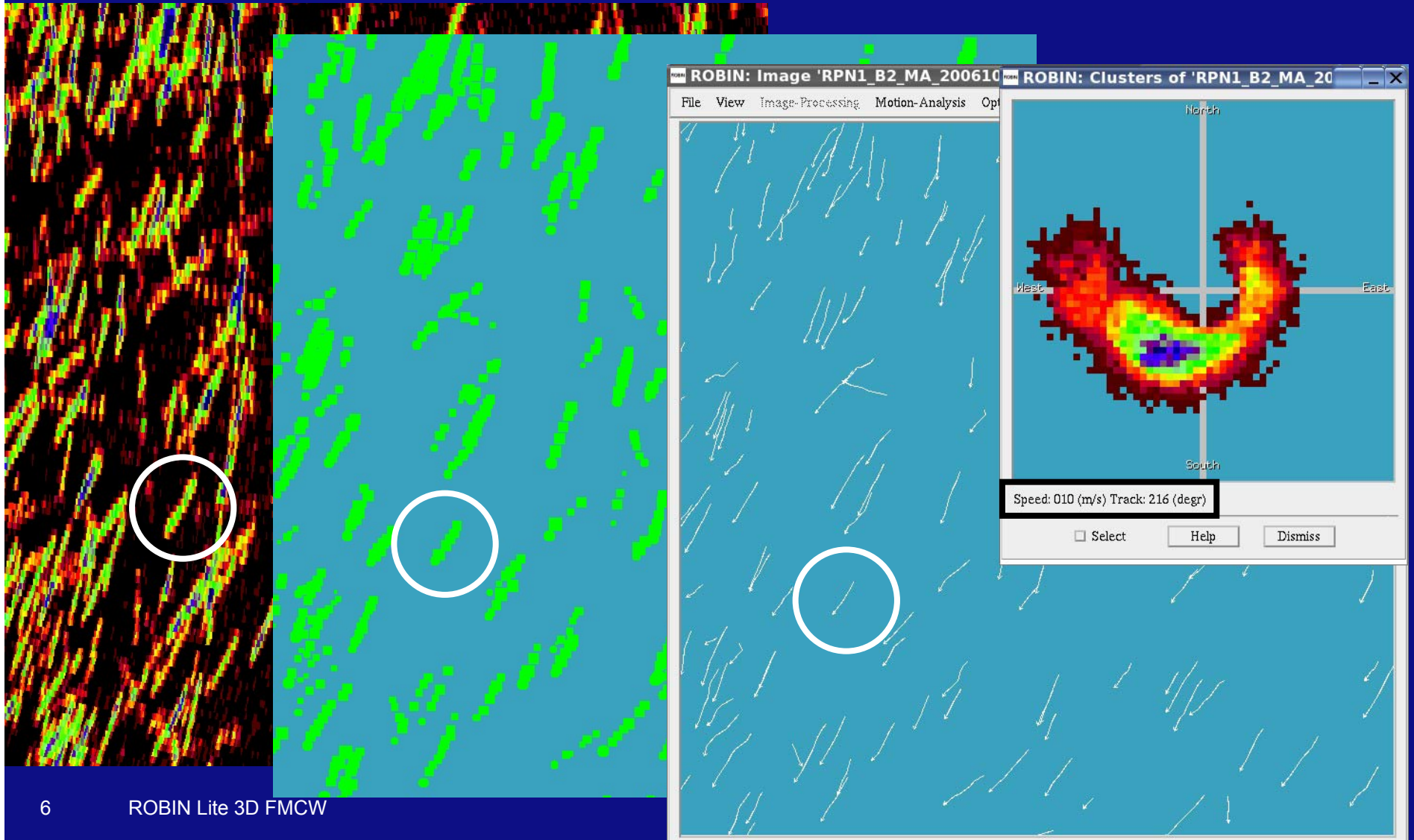


# Our roots in avian radars



- Bird detection radar technology since seventies
- Various long range bird detection systems delivered to:
  - Royal Netherlands Air Force
  - Belgian Air Force
  - French Air Force
- Long range:
  - Single birds 65 km
  - Flocks 120 km
  - (aircraft 250 km)

# From raw radar data to realtime info bird movements



# ROBIN Lite 3D FMCW: System design requirements driven by users



Avian radar to support the main birdstrike prevention applications:

- Real-time and mobile display of all bird movements to Bird/Wildlife Control
- Continuous database storage of all bird information for:
  - biological analysis
  - habitat management
- Real-time display of dangerous tracks/bird strike danger to ATC

# Main avian radar system requirements

- Cover all airspace relevant for birdstrike prevention
  - up to ground level
  - maximum allowable altitude range
  - sufficient horizontal range
- 3D info of birds at 360° around radar
- Exact altitude info
- Realtime and automated
- Species discrimination capabilities
- Low cost



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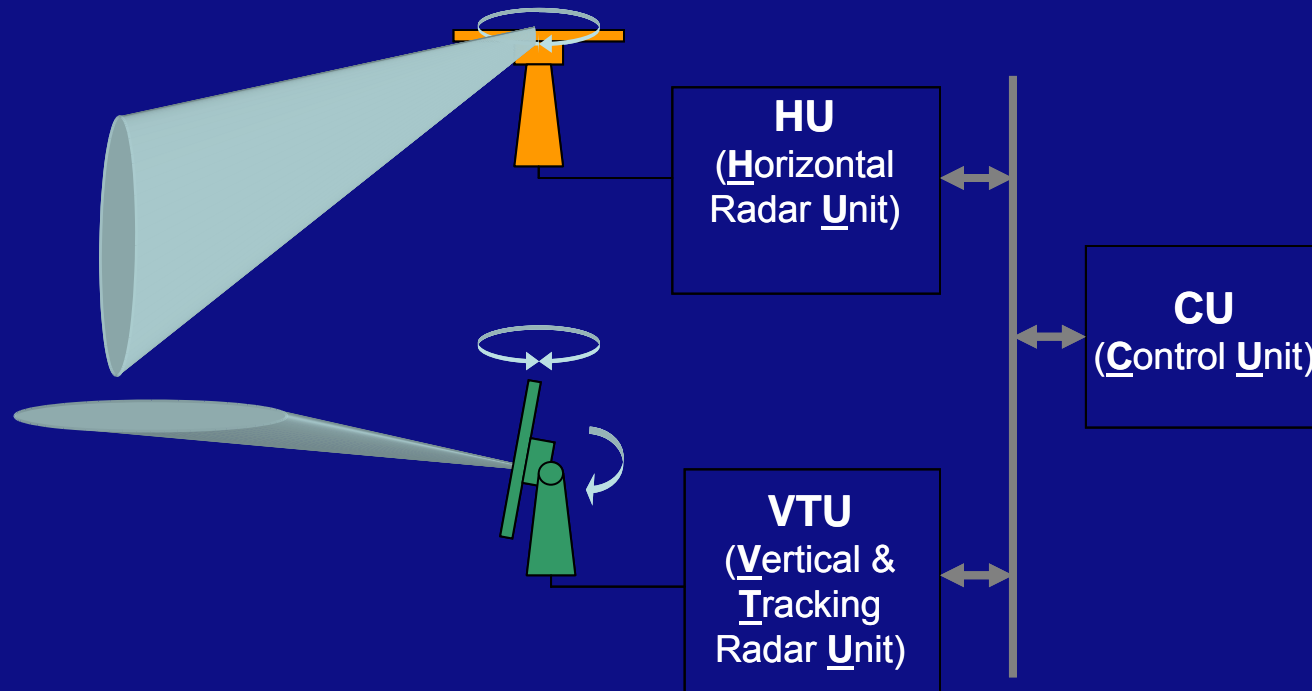
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# System design conclusions ROBIN Lite 3D FMCW



# ROBIN Lite 3D FMCW implementation

- Horizontal radar: T-bar maritime radar antenna
  - provides excellent 2D capabilities for a low price
  - high altitude coverage/volume scanning due to radar beamwidth of 20°-25°
  - 4°-8° pencilbeam antenna has insufficient volume scanning
    - ‘pencil light’ in the dark
- Vertical radar: dual transmit/receive FMCW antenna
  - solid state coherent radar
  - Frequency Modulated Continuous Wave (FMCW) radar technology with remarkable capabilities
  - excellent altitude discrimination
  - a rotated horizontal radar antenna is not optimal
    - excellent altitude discrimination
    - mechanically fixed to one direction only (not 360° coverage)
    - mechanical mis-using of radar (bearings)
  - pencilbeam of 4°-8° width has insufficient altitude discrimination



# ROBIN Lite 3D FMCW: Horizontal radar

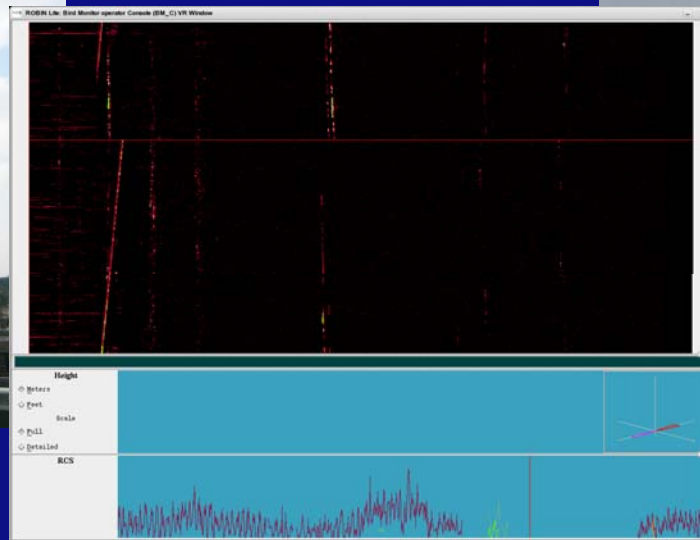
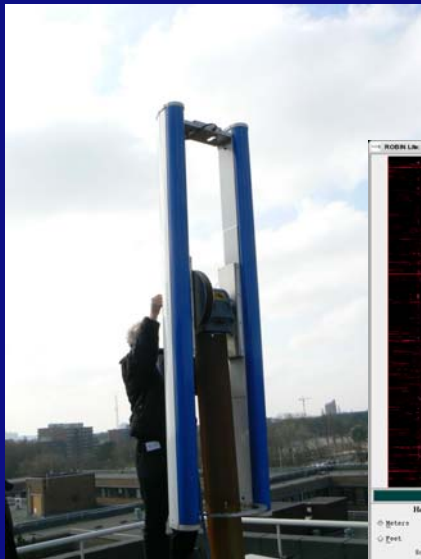
- Furuno radar antenna being used, but all vendors/types possible
- TNO designed antenna tilt mechanism for doubling altitude coverage
- highest rotation speed, a radar hit per 1.2s leading to:
  - more radar hits
  - better quality of birdtrack calculation
  - lower False Alarm Rate
- X-Band:
  - higher sensitivity for passerines
  - susceptible for weather
- S-Band:
  - longer range
  - only larger birds

Movie2.mpg



# ROBIN Lite 3D FMCW: Vertical radar

- FMCW radar with 700mW power
- Range: 3,5km (but adaptable)
- Range resolution: 2m
- Steerable to all targets
- No cone of silence above radar
- Detection of wingbeat pattern
- Detection of separate birds in flock



## ROBIN Lite 3D FMCW: Data acquisition electronics

- TNO designed data acquisition electronics
- Dedicated to bird detection application
- Highest capabilities in the market
  - 120MHz, shortest range cell (2,5m)/highest resolution
  - 14bits Signal Noise Ratio (SNR) depth
  - optimal mapping of radar signal at A/D converter



# ROBIN Lite 3D FMCW Signal/image processing

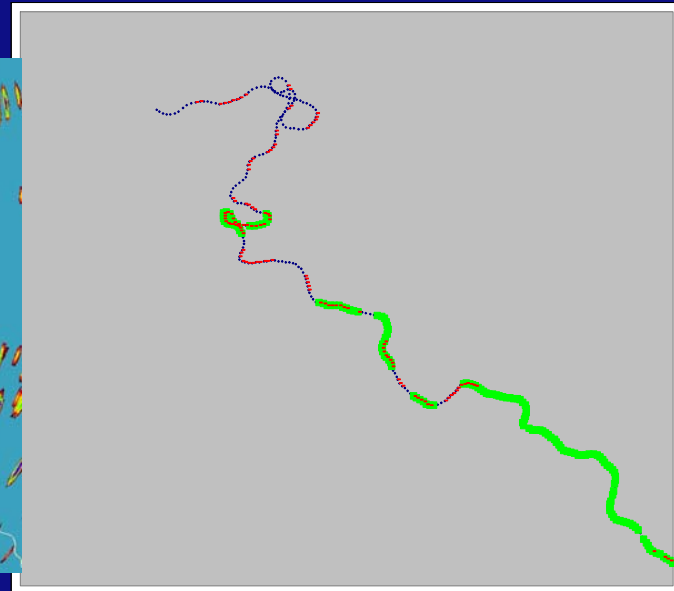
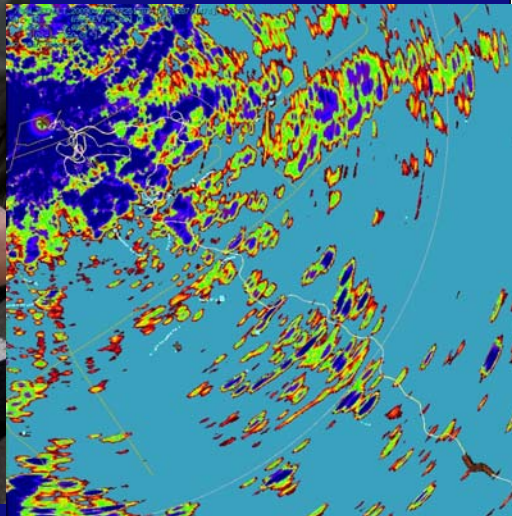
*'Core of the system'*

- Signal stabilization for changing propagational conditions
- Dynamic adaptive clutter filtering, no static clutter maps
- Dedicated tracker algorithm for bird detection
  - combined realtime Kalman/heuristic filter
  - filling of tracks of missing radar hits
- All bird information stored in meta db for analysis



## ROBIN Lite 3D FMCW ground clutter filter

- Majority of birds to be found at low altitude
- Make sure that you have radar coverage up to ground level
- Filter for ground clutter, without removing the bird reflections
- Worst case trials at TNO location:
  - radars located very high, looking at extreme clutter-rich area
  - GPS tracker equipped pigeons could be tracked up to 5km
- Rabbits on field were detected at 1km distance
- Medium sized bird flying at 1m altitude at 2km



# ROBIN Lite 3D FMCW visualization

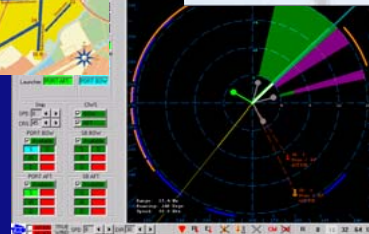
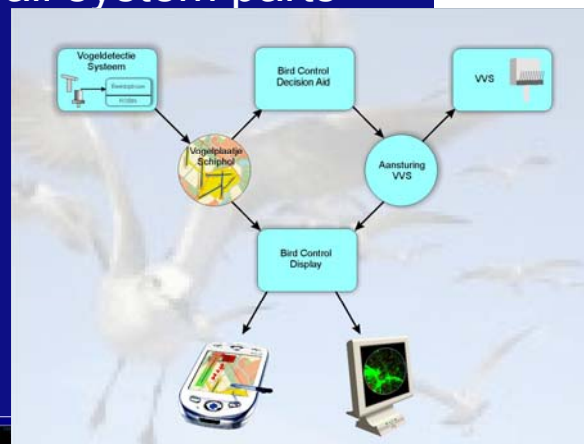
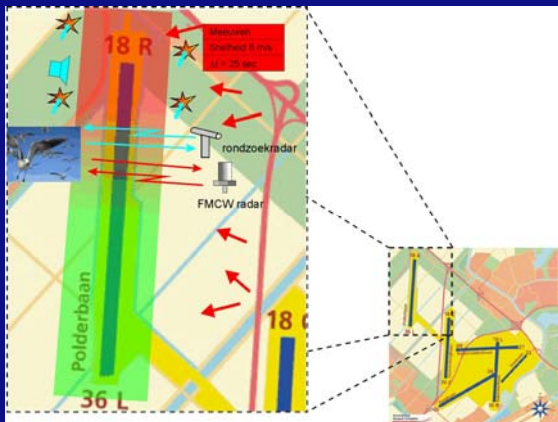
- Various ways of visualization
- GIS applications like Google Earth
- Realtime display over internet
- Mobile display in bird control car
- Remote access and control
- Unattended operation
- Multi user/multi application data x-fer
- Automated output
- Mobile/transportable display (PDA/laptop) in BCU car on field
- Wireless connection on airport



- Ask your avian radar vendor always capability to display synthetic bird tracks on top of radar image:
  - indication of quality of signal processing
  - indication of quality of tracker

# Future perspective: TNO's Bird Detection & Expel System

- Real-time autonomous system to prevent birdstrikes on and above runways
- Consists of:
  - ROBIN Lite
  - Bird Control Decision Aid
  - Bird deterrence devices around runway
  - Bird Control Display
  - TCP/IP WAN connecting all system parts



## ROBIN is going to the market

- TNO expects the ROBIN product family to be a success
- TNO as R&D organization is not best place to further industrialize
- ROBIN will be delivered and supported from a separate organization:
  - as part of an industrial party
  - or
  - as a spin off company of TNO
- Decision expected before the end of Sept 2009
  
- If you have any questions, feel free to ask
  
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