Low-cost single-chip radar design and applications at 60 GHz

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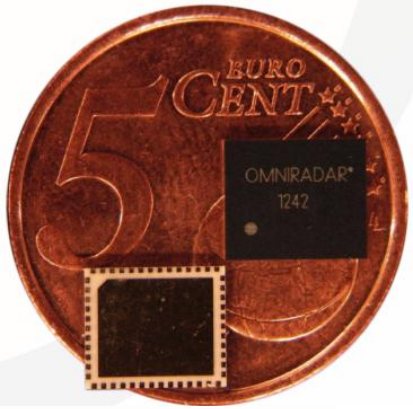
Our Mission

to be a major supplier
of innovative integrated radar IC's

for consumer, industrial and
automotive markets,

leveraging the knowledge on
radar in The Netherlands.



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Problems
Presence Sensor Technology

	24 GHz NB Radar	24 GHz UWB Radar	77 GHz Radar	79 GHz Radar	Mono Video	Stereo Video	PMD Sensor	Far IR Sensor	Near IR Sensor	Laser Scanner	Ultra-sonic
Operation in dust or hail											
Operation in fog or snow											
Low sun and dazzling											
Day and night operation capability											
Sensor blockage risk (e.g. dirt on sensor)											
Mounting constraints on vehicle											
Surface/Cover transparency constraints											

= good performance = fair performance = bad performance

MOSARIM FP7 project

Most sensors cannot handle harsh environments .

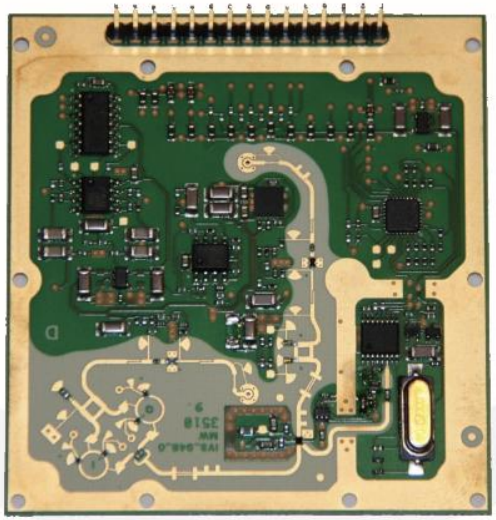
Problems
Current Radar Technology

Discrete solutions = costs

24 GHz bandwidth = no resolution

Higher frequency = complex

Expert design work = costs



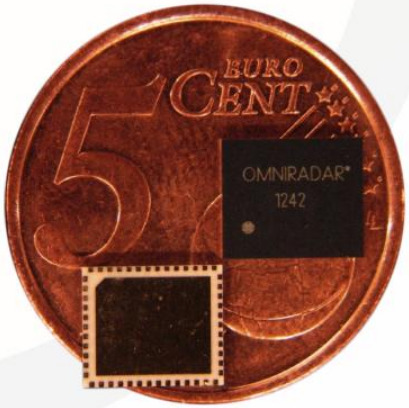
Value Proposition

We take the microwave hassle out of engineering

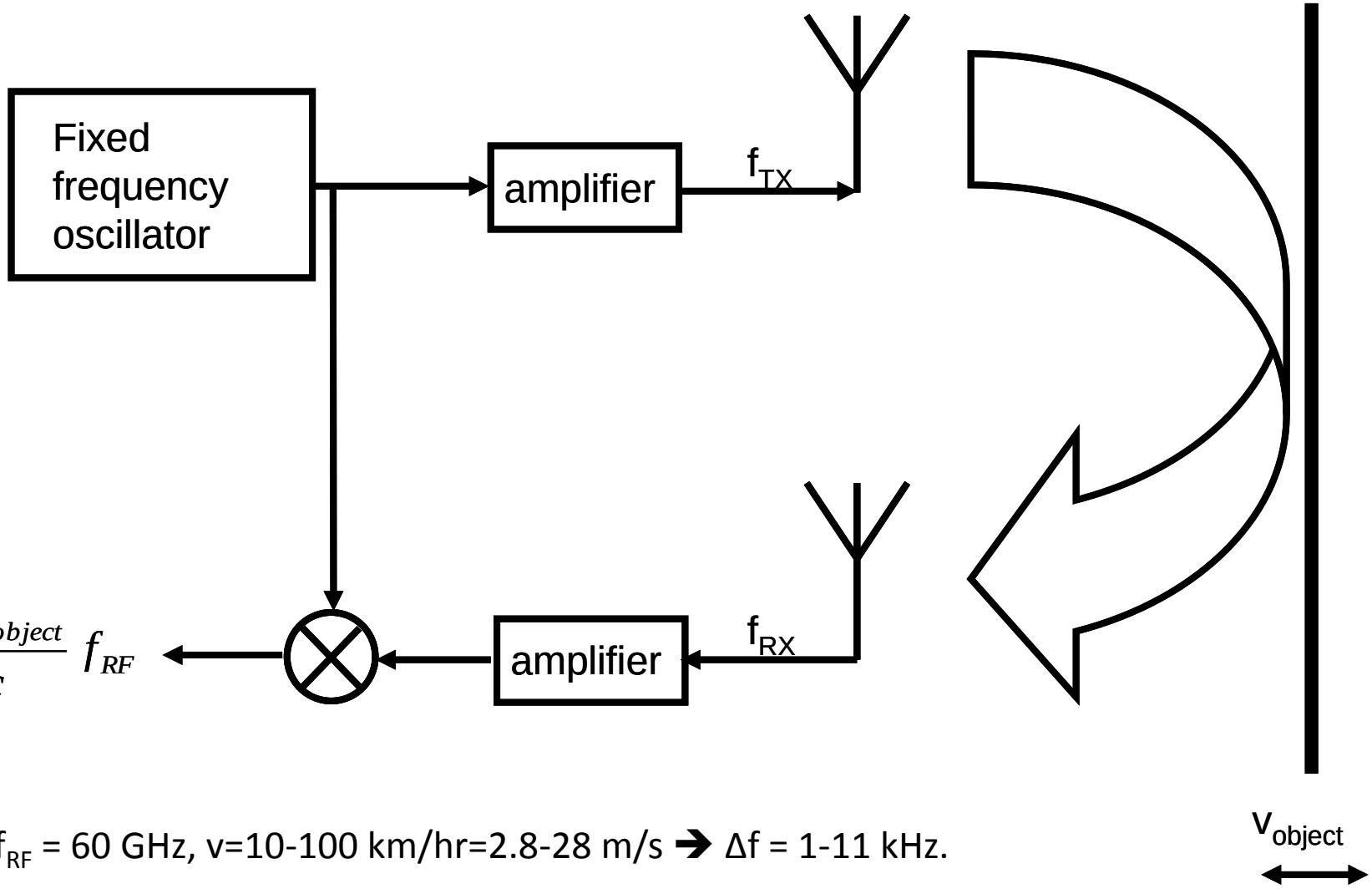
We bring radar technology to industrial and consumer markets

with our solution:

Fully Integrated 60 GHz high bandwidth frontend RADAR with antenna's



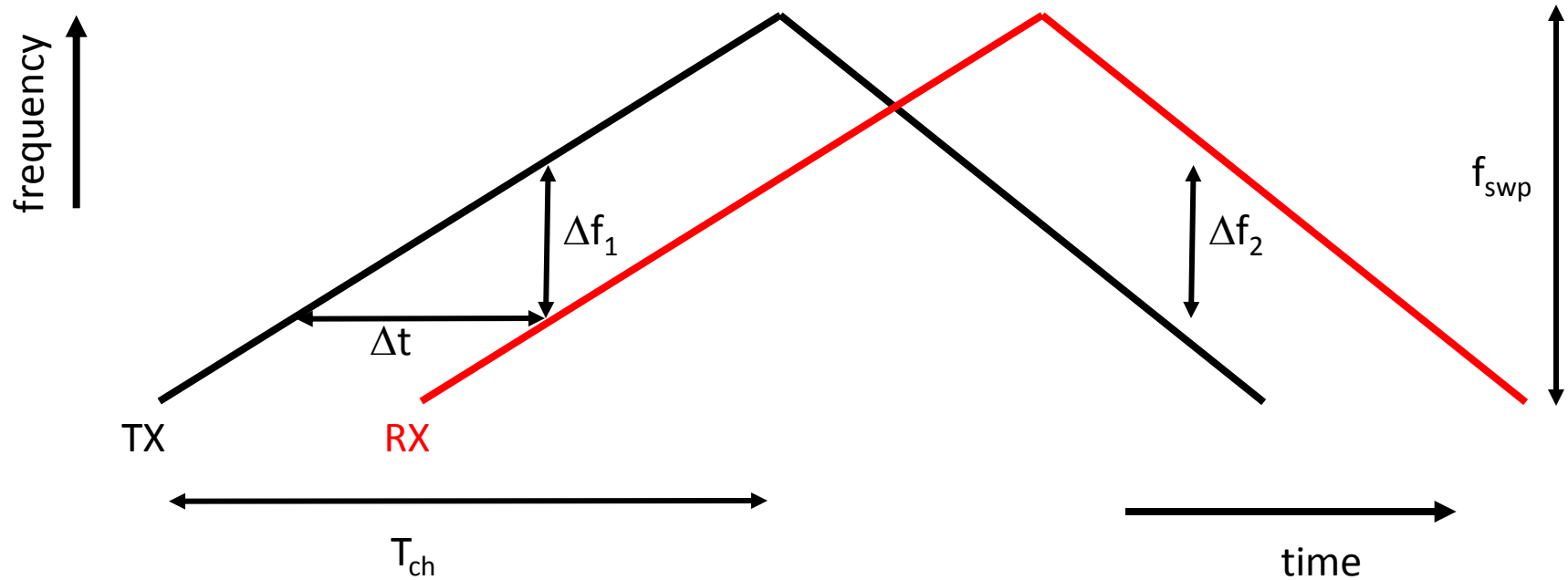
Doppler radar



$$\Delta f \approx \frac{2 \cdot v_{object}}{c} f_{RF}$$

Using f_{RF} = 60 GHz, v=10-100 km/hr=2.8-28 m/s ➔ Δf = 1-11 kHz.

FMCW radar



- Triangular frequency modulation (many other patterns possible).
- Measures both distance ($d=(\Delta f_1+\Delta f_2)*T_{ch}/f_{swp}$) and speed ($v=(\Delta f_1-\Delta f_2)*c/(2*f_{RF})$).

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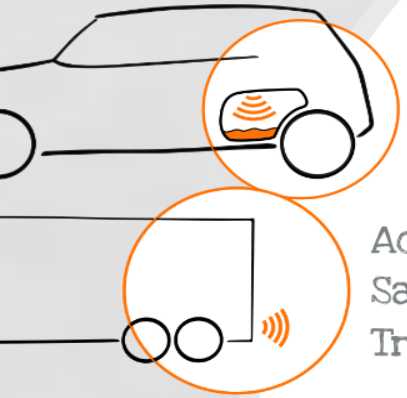
Opportunities

benefits



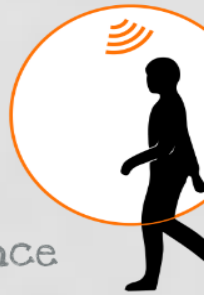
Level Gauging Automotive

Active Safety Trucks

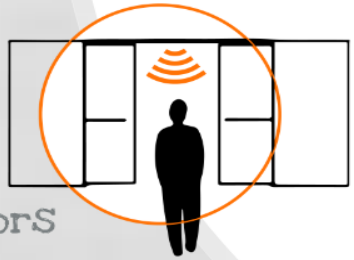
Level Gauging

Parking Sensors

Lighting



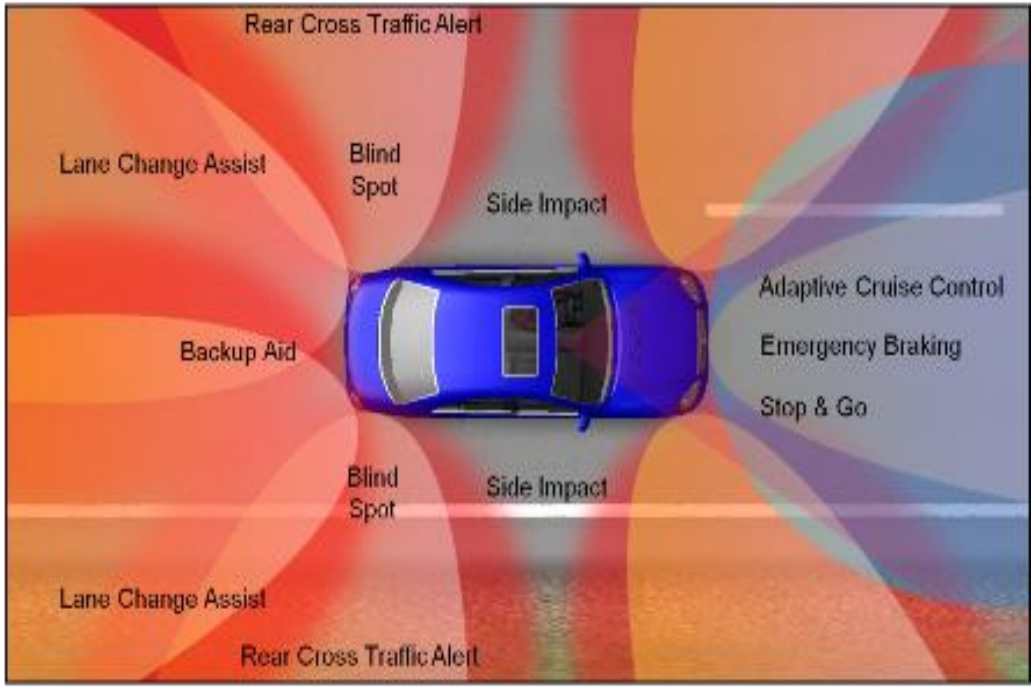
Presence



Doors

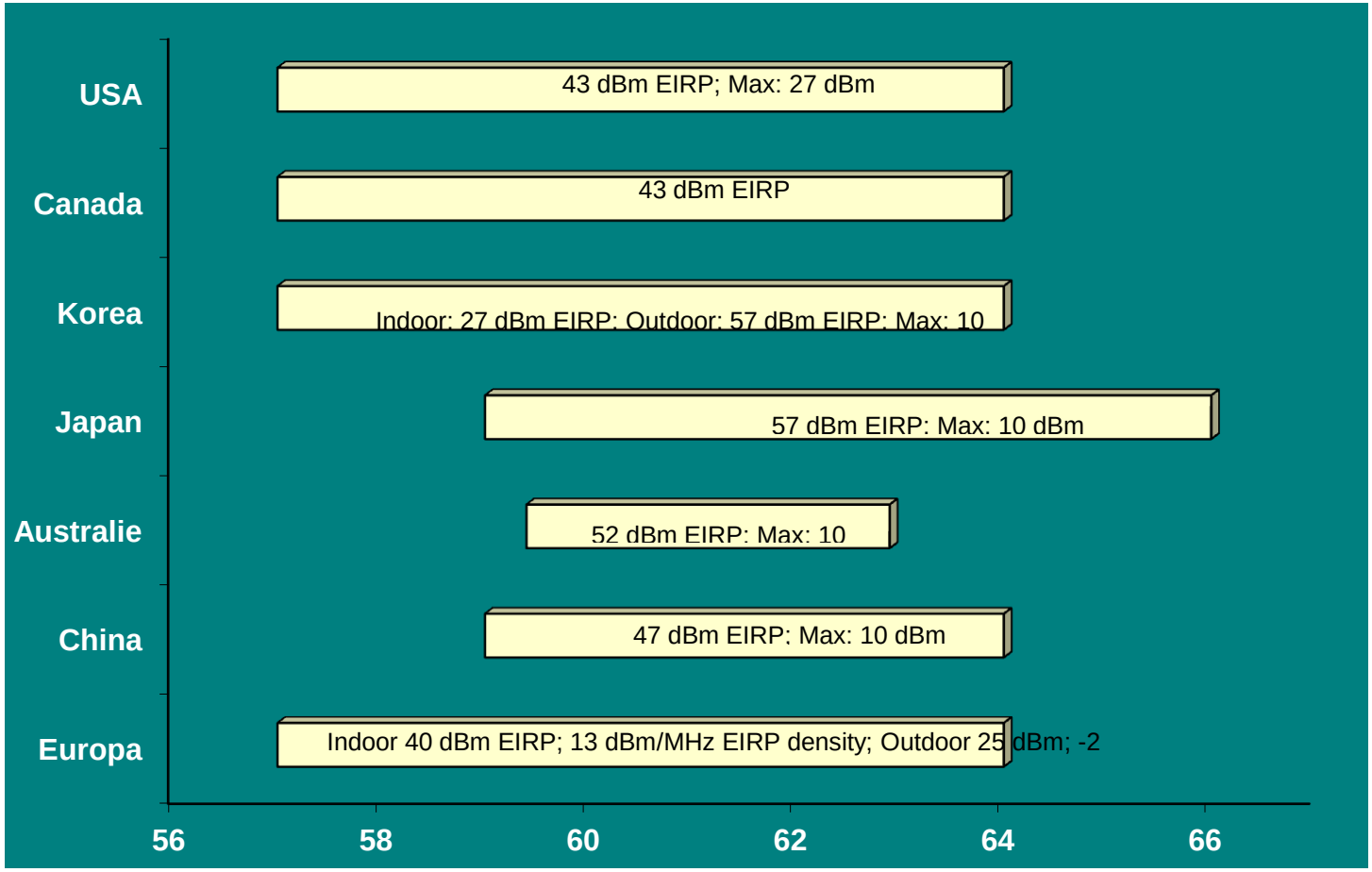
Better performance, smaller outline and lower pricepoint will open up many applications for ranging, velocity, imaging.

More opportunities.



- UAV applications.
- Car applications.
- Automatic Guided vehicles.
- Speedometer.
- Intruder alarms.
- Proximity switches in sanitary equipment.
- Robot sensors for proximity and speed.
- Ultrasound transducer replacement.
- Standard “radar” component for all engineers.

Why the 60 GHz ISM band?



Source: agentschap Telecom

Small applications possible (wavelength=5 mm).

IC architecture 1(2)

- Generic solution for FMCW, FSK, doppler radar applications.

- 7 GHz bandwidth ➔ 4 cm resolution

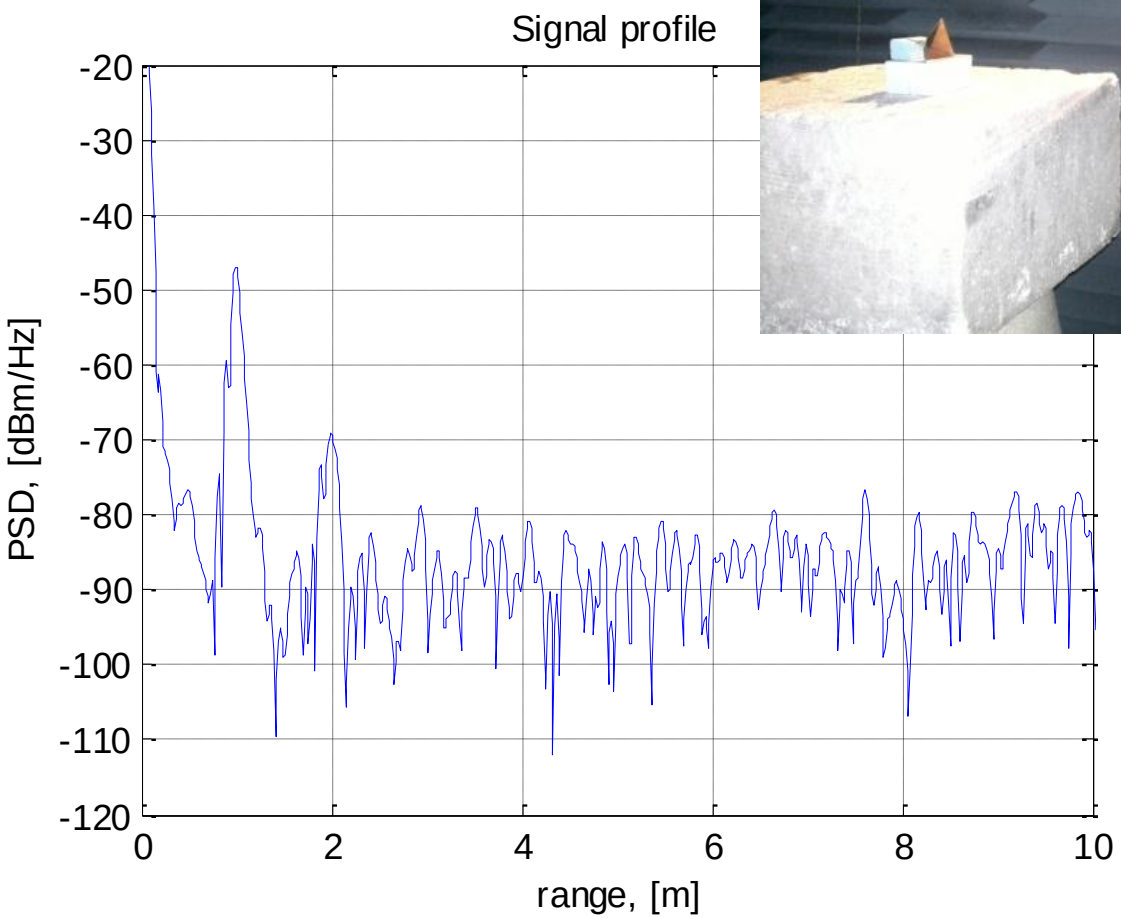
- 2 * RX: direction of arrival
- RX I/Q: direction of object-movement.

- PLL
- Low-cost XTAL (10-50 MHz)
- Analog or digital IF output

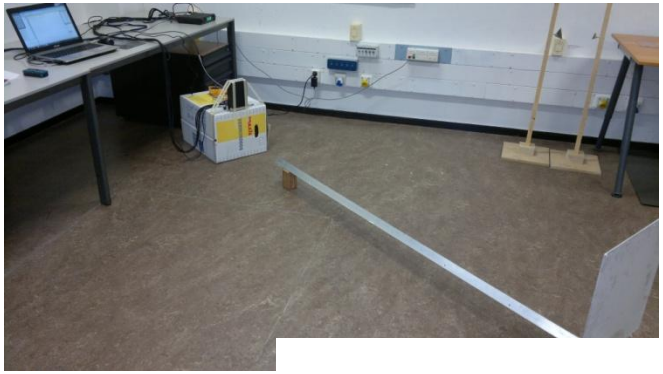
IC architecture 2(2)

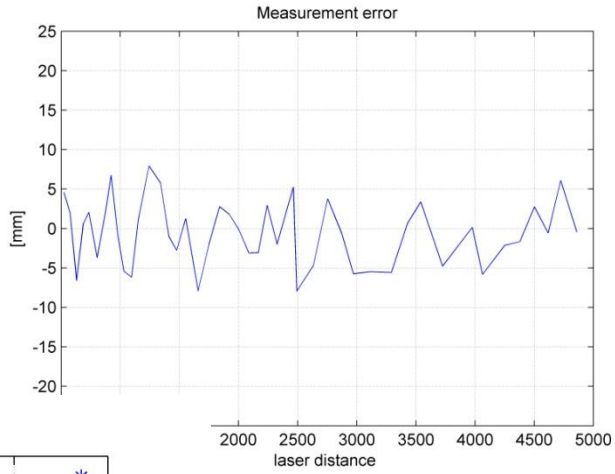
- Single supply (2.6-2.9 V) via on-chip low-dropout regulators.
- “SW programmable radar” to program various functionality (150 bits) via SPI.
- Antenna on-silicon or in the package.
- For our customers:
  NO hassle in RF board or antenna design
- Just connect power supply, signal processing unit and have a working radar!

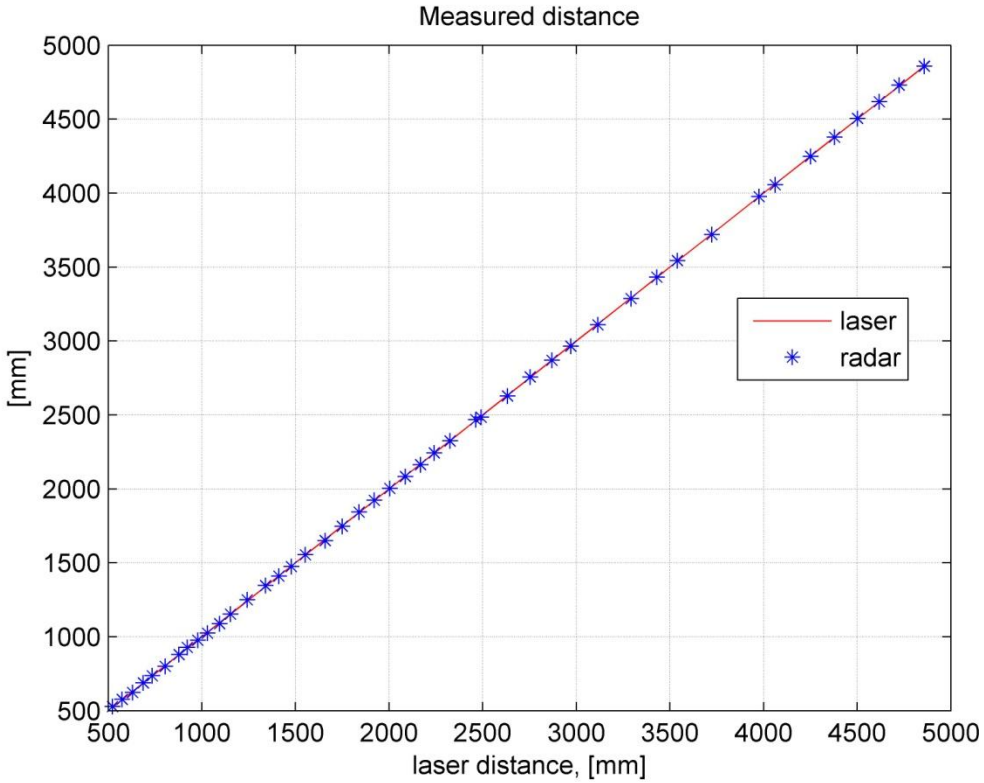
Measurements



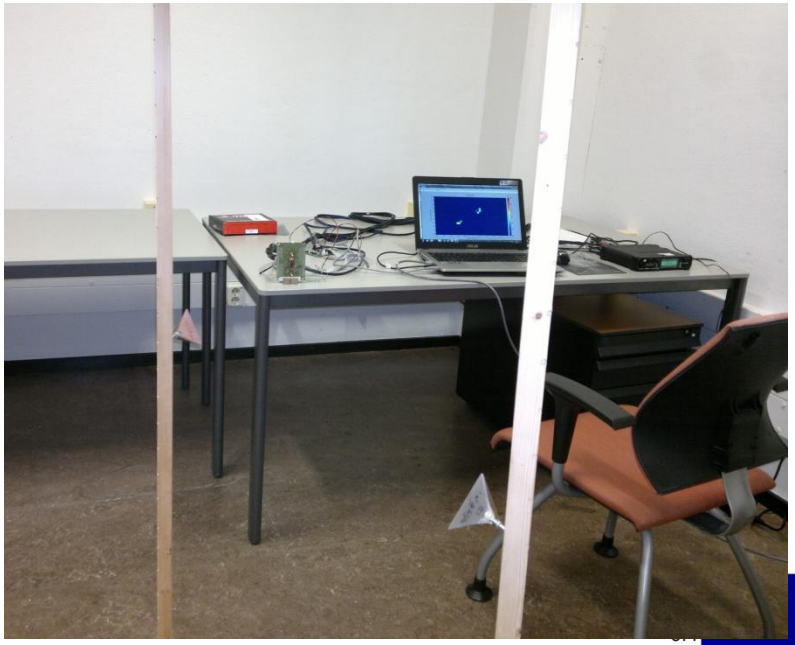
Distance Measurement

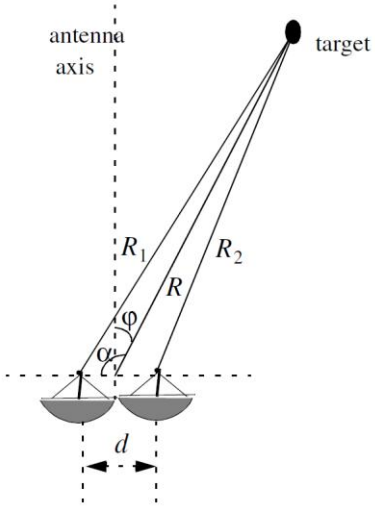


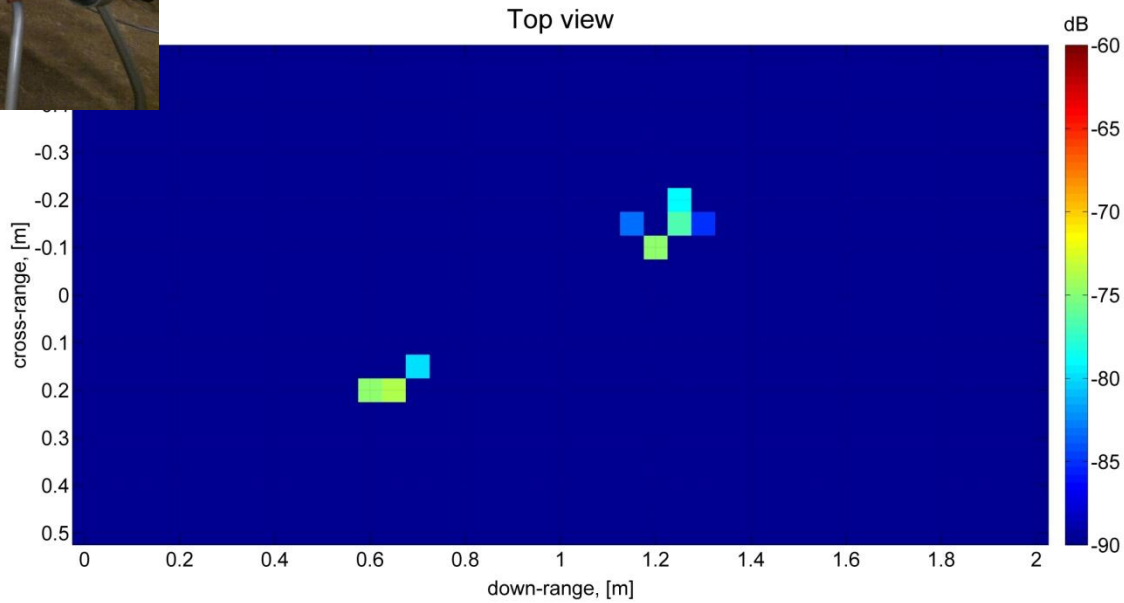




Angle of arrival







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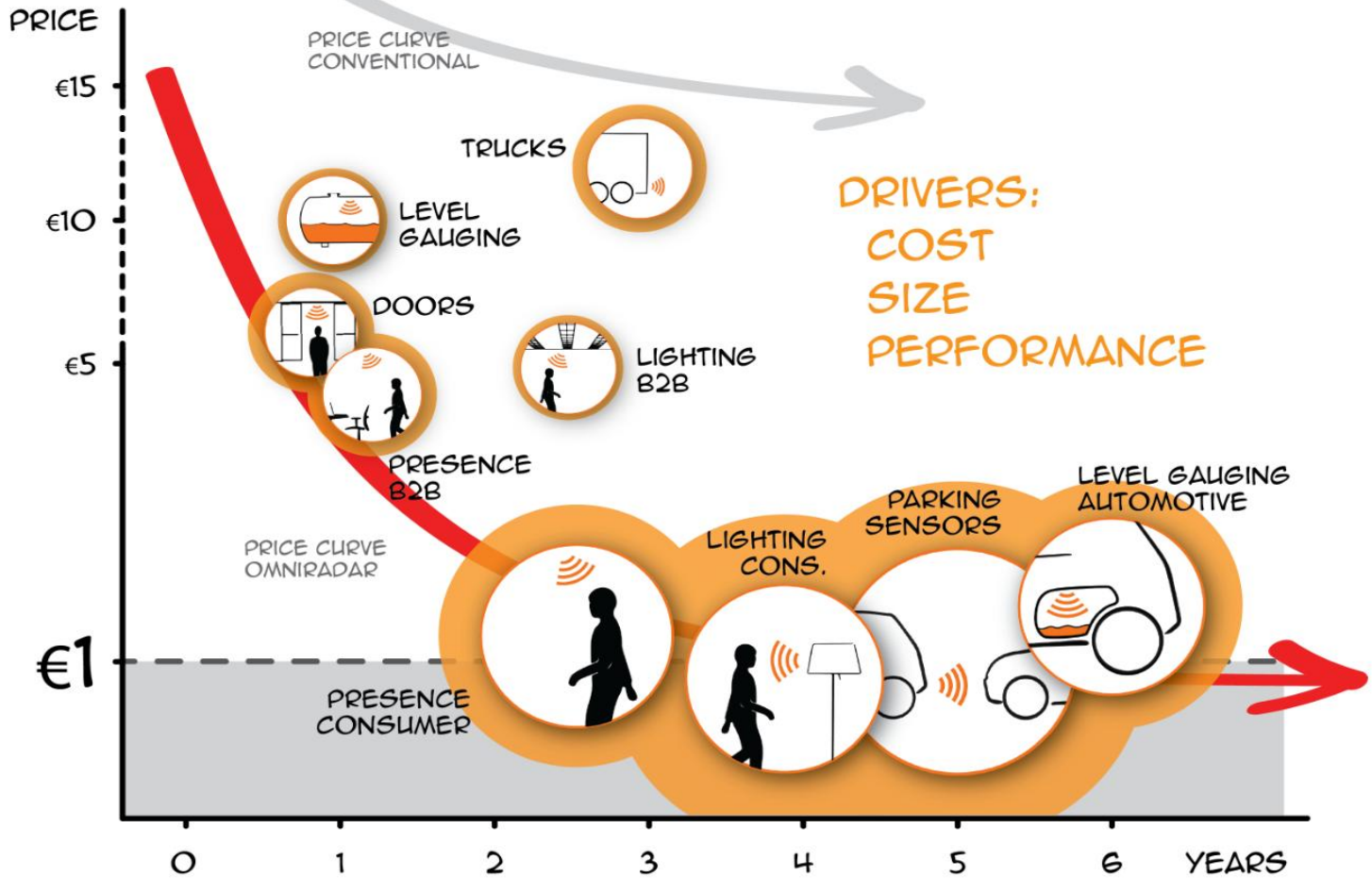
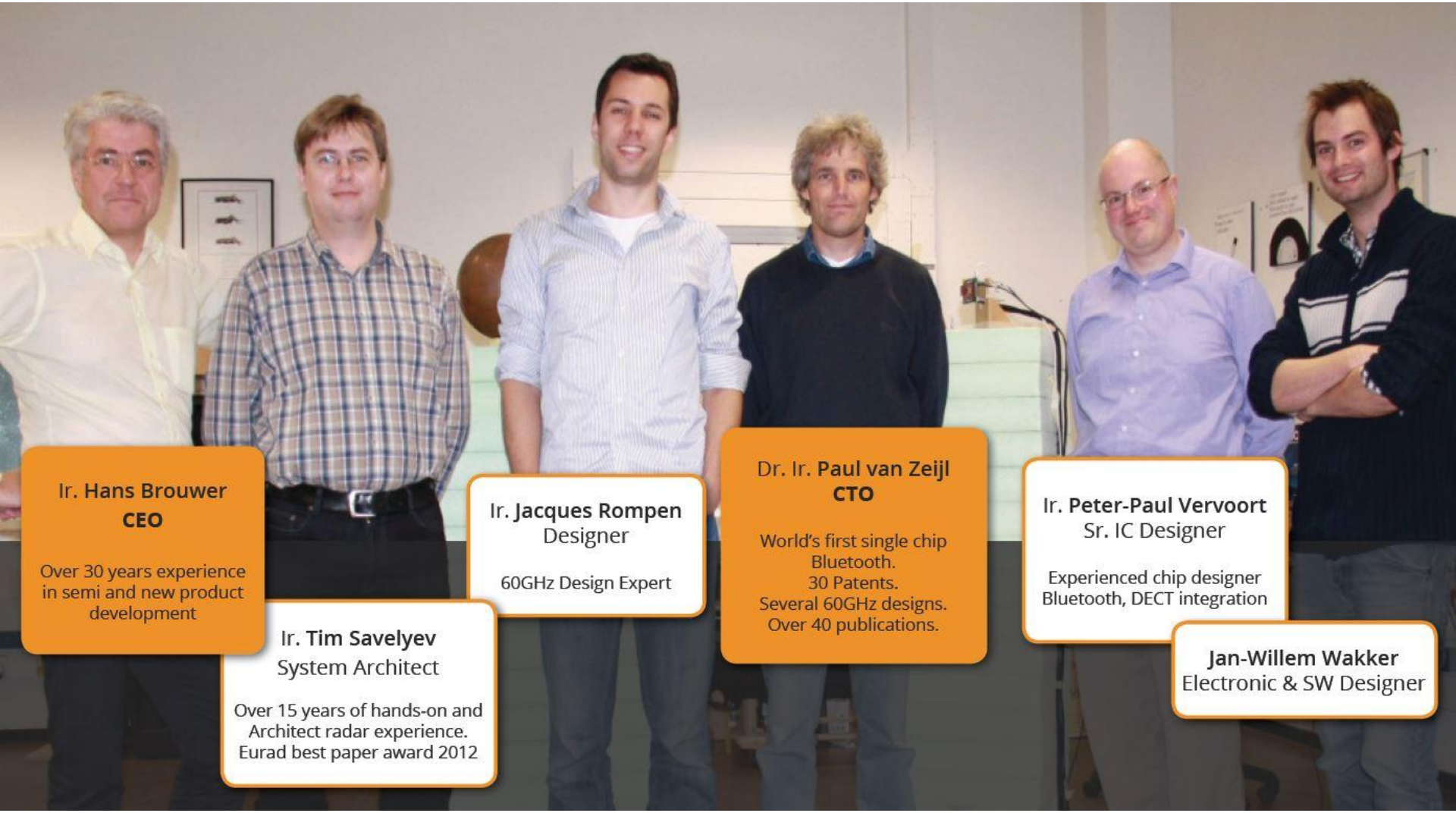
UNLOCKING POTENTIAL OF INTEGRATED RADAR



The Team


Ir. Hans Brouwer
CEO
Over 30 years experience in semi and new product development
Ir. Tim Savelyev
System Architect
Over 15 years of hands-on and Architect radar experience.
Eurad best paper award 2012
Ir. Jacques Rompen
Designer
60GHz Design Expert
Dr. Ir. Paul van Zeijl
CTO
World's first single chip Bluetooth.
30 Patents.
Several 60GHz designs.
Over 40 publications.
Ir. Peter-Paul Vervoort
Sr. IC Designer
Experienced chip designer
Bluetooth, DECT integration
Jan-Willem Wakker
Electronic & SW Designer

Conclusions

- Summarized problems in state-of-the-art presence sensor technology and radar technology.
- There are lots of opportunities for radar.
- Our value proposition is a **one-chip-radar** at 60 GHz:
  NO hassle in RF board or antenna design for our customers.
  Connect power, signal processing unit and start measuring.
- Shown the IC architecture and two designs:
  - Antenna on-silicon
  - Antenna in-package
- We have demonstrated radar measurement results (distance, angle-of-arrival).

"The successful realization of such items as phased-array antennas, for example, using a multiplicity of integrated microwave power sources, could revolutionize radar"

Gordon Moore, April 19, 1965

Revolutionizing Radar...