Subject Increasing Automotive Safety through Embedded Radar Technologies

Radar Transceiver Chipset + Qorivva MCU

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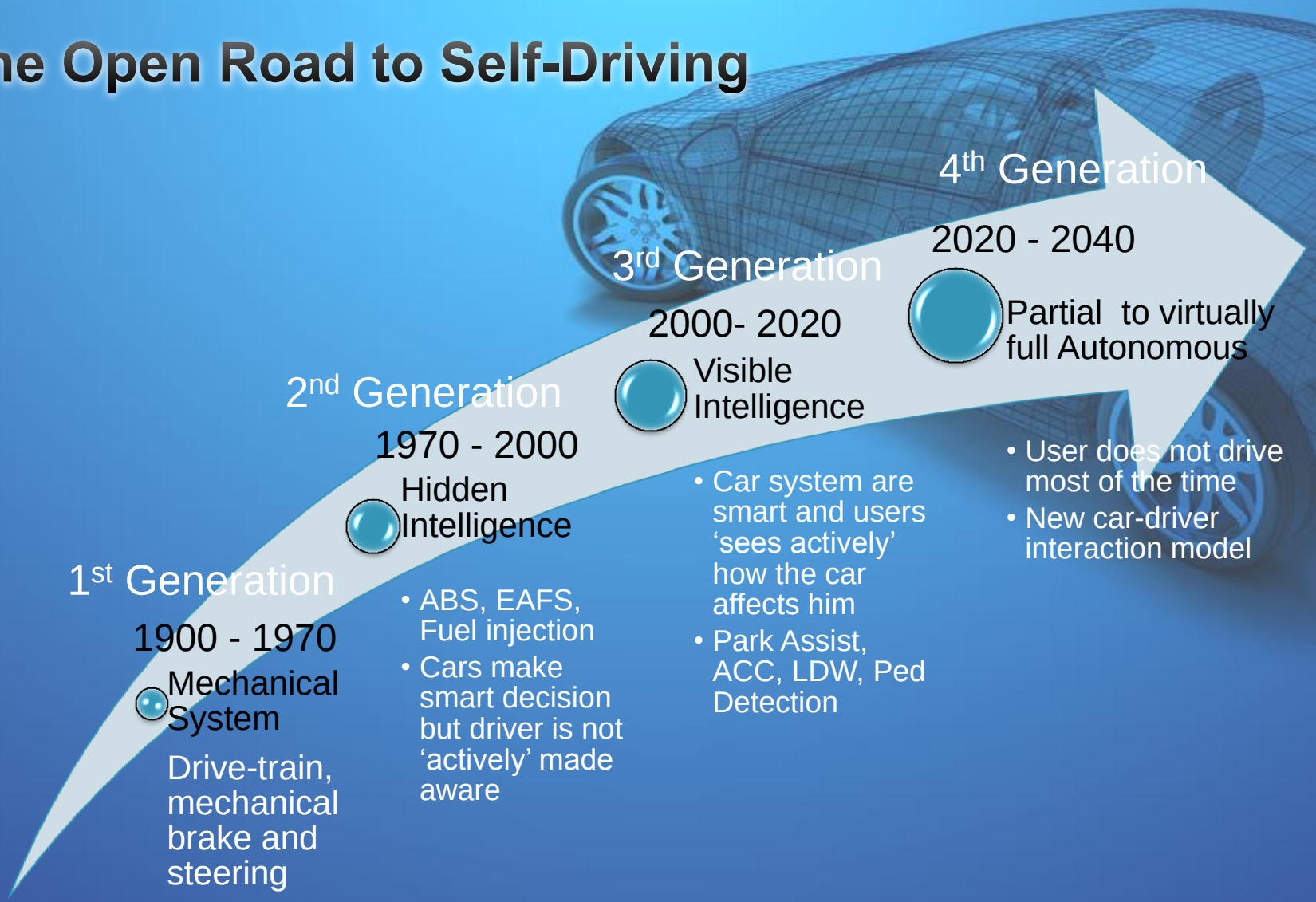
The Open Road to Self-Driving



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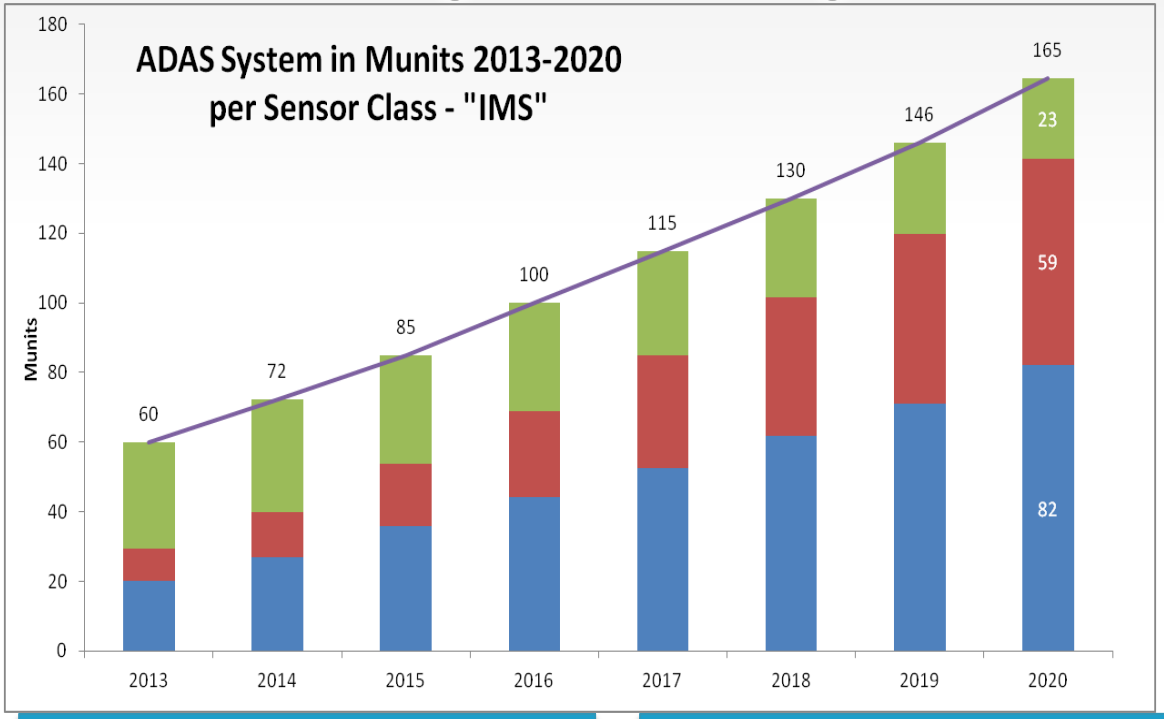
ADAS : Fast growth – High Innovation

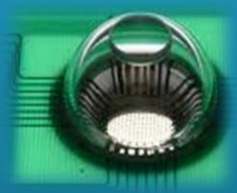


Sensor	Units / CAGR %
Vision Sensor (Blue):	82M u/ 22%
Radar-Lidar (Red):	59Mu/ 30%
Ultra Sonic(Green):	23Mu/ -4%
Total:	**164Mu/ 16%**

- *Strong Growth of Sensor*
- *360° Sensing & NCAP*
- *Two major Technology !!*
  - *77GHz and MegaPixel*
- *U-sonic in decrease*
- *No long term LIDAR*
- *Night Vision smaller*

Camera Sensors

- Smallest Size – High system flexibility
- Largest FOV + increasing Pixel
- density
- Power reduction – ISP & ICP
- Largest Volume and take rate



Radar Sensors

- Larger Size ⇒ integration of component
- Longest range (200 meter+)
- Power Reduction – Scalability
- Distributed Computational load
- Most complete Sensor and good Take rate

Ultrasonic Sensors

- Small Size – Negative growth - mature
- Close range accuracy (few cm)
- Large number used per vehicle
- Only for park assist and in negative growth

IMS Research - Feb 13`

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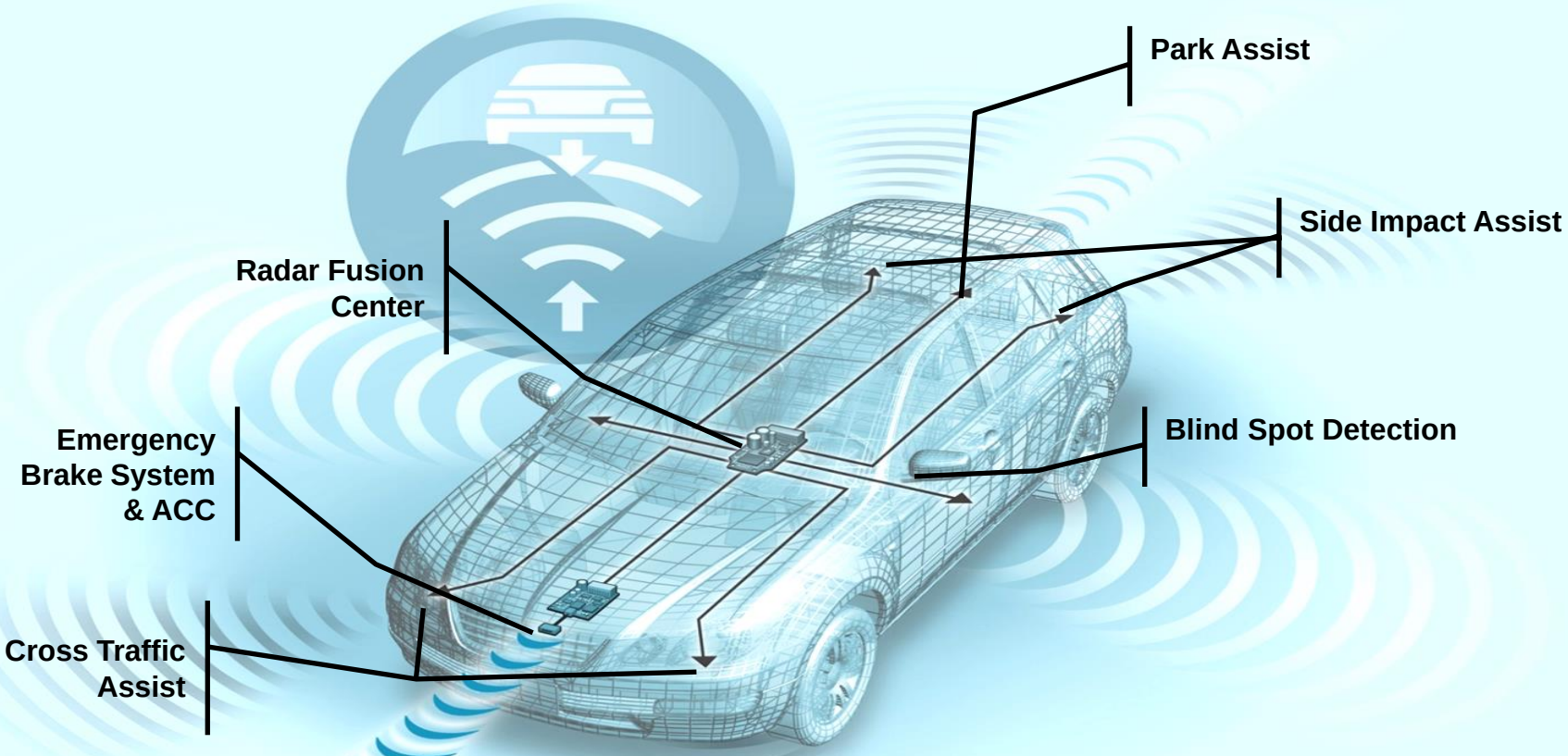
Automotive ADAS Radar Applications



Key Trends:

1. Large increase of sensors to support 360° sensing
2. Strong Cost Reduction
3. Miniaturization

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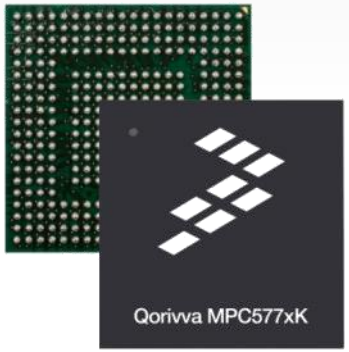
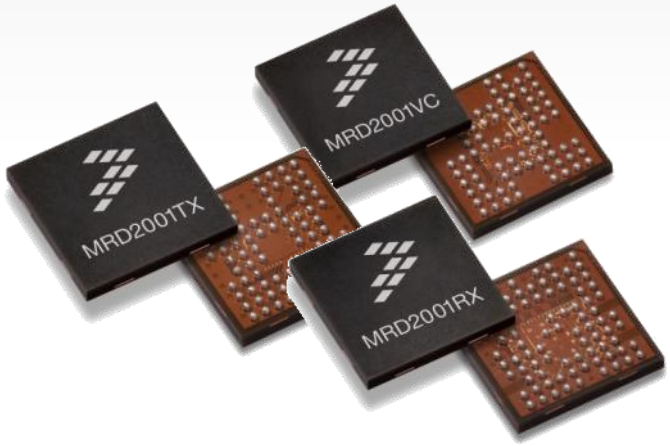
Introducing Freescale ADAS Radar Solutions





Delivering industry-leading levels of performance and integration needed for highly-complex radar applications.

Industry's first complete high-performance packaged radar chipset, scalable for transmitting and receiving multiple channels.

Together – the industry's most complete system-level ADAS solution for automotive radar

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MRD2001 77 GHz Radar Transceiver Chipset

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Introducing the New MRD2001 77 GHz Radar Transceiver Chipset

Industry's first complete high-performance packaged radar chipset, scalable for transmitting and receiving multiple channels.

Multi-Channel, Scalable – Supports a maximum of 4 transmit channels and 12 receiver channels, enabling a single platform to support all LRR, MRR, and SRR applications from budget to luxury vehicles.

Advanced Packaged Technology – Available in an advanced fan-out wafer-level package that minimizes parasitics and interference, ensuring the highest performance on the customer PCB.

High-Performance – Provides the best radar phase noise in the industry, enabling precise location of objects. The total transceiver consumes only 2.5 W, saving energy and heat.

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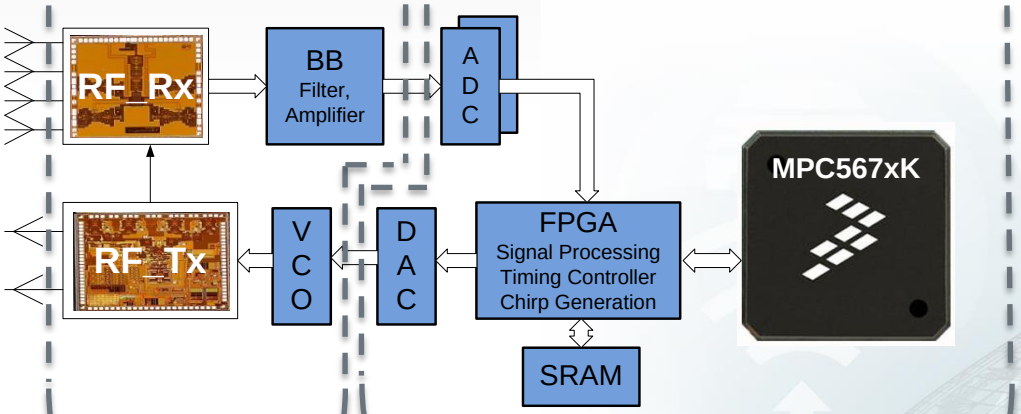
77Ghz Radar System

Previous Generation vs Next Generation

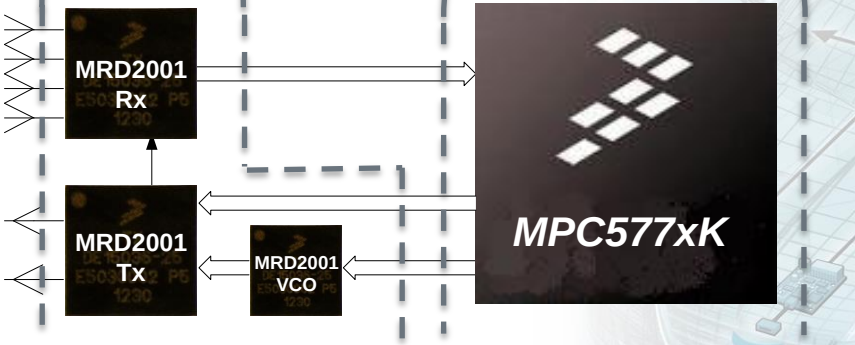


Previous Generation

Next Generation

MRD2001 77 GHz Chipset

- **Replaces:**
  - Bare Die RF solutions with a RF Chipset based on RCP package technology
  - Discrete Filter Components and Amplifiers
- **Enables:**
  - Significantly lower assembly cost
  - Lower PCB cost



Qorivva MPC577xK

- **Replaces:**
  - 8 ADC
  - 1 DAC
  - 1 FPGA
  - External SRAM
  - General purpose MCU
- **Enables:**
  - Significant PCB area saving
  - Reduced assembly cost

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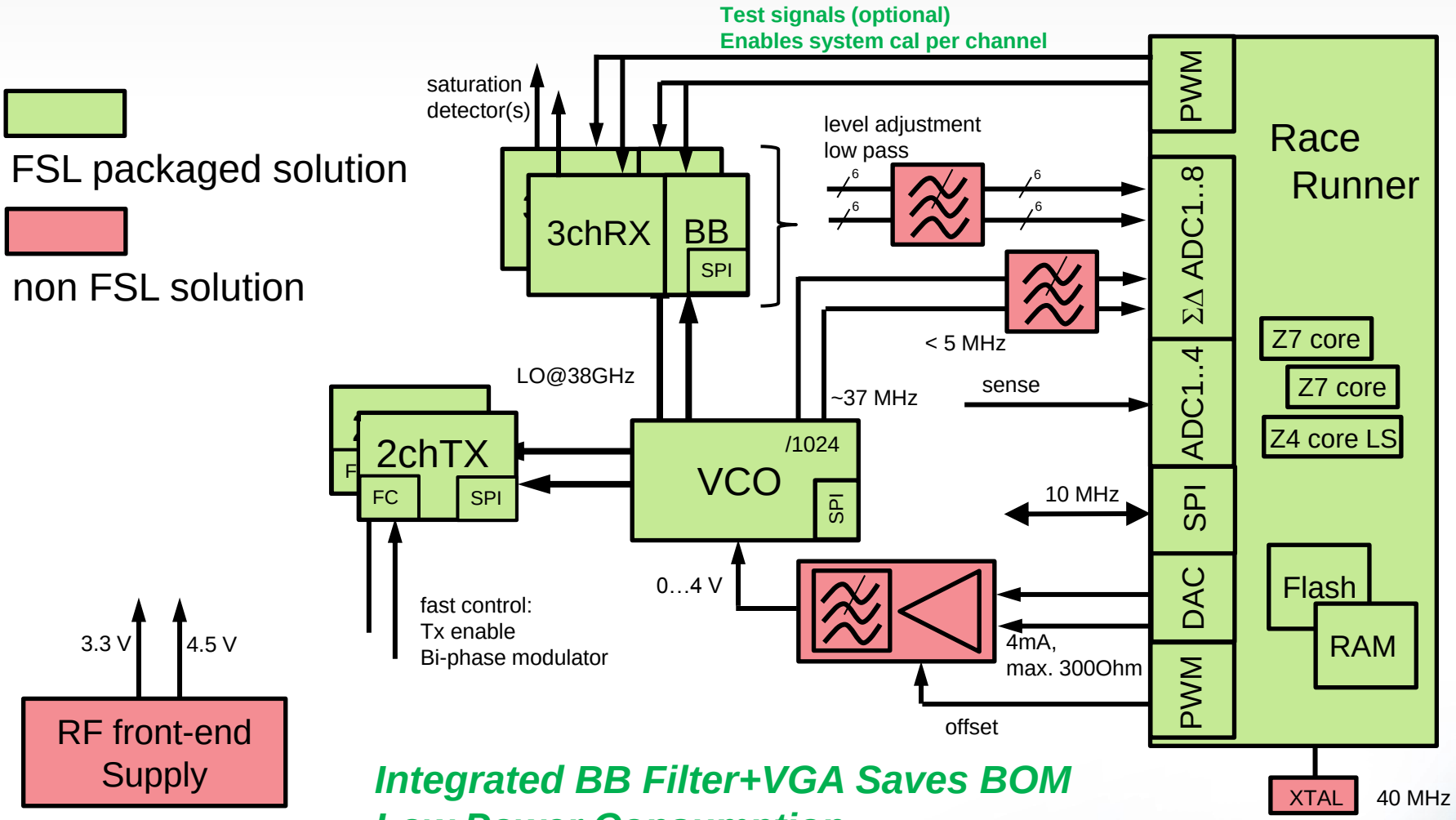
Packaged Transceiver Spirit Chipset

Open Loop VCO Supporting Fast Modulation



Integrated BB Filter+VGA Saves BOM

Low Power Consumption

Scalable to 4-Ch TX + 12-Ch RX

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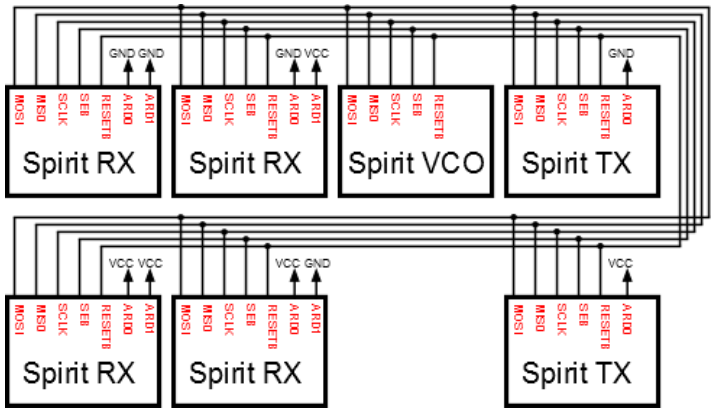
Common Features

- 6 mm x 6 mm RCP BGA package (0.5 mm pitch)
- Only most outer 2 rows are used for control signals
- Temperature Range -40°C up to 125°C (ambient)
- Temperature Sensor
- Power/Peak Detector
- SPI Control (max. guaranteed 10 MHz)
- Tri-State Sense Output
  (One Signal Line can be shared)
- 2 External Resistors (E96, 1%) per Chip
  to lower ICC spread
- “Software” Addressing of Chips instead
  of dedicated hardwired “chip select”

Spirit ES2 RX Bottom View (Dead Bug)

	1	2	3	4	5	6	7	8	9	10
L	GND	GND	GND	GND1		GND1	GND	VCC1	GND	GND
K	GND1	GND1	GND1	GND1	LO	GND1	GND	GND1	GND1	GND1
J		RX1	GND1	GND1	GND1	GND1		GND1	RX3	
H	GND1	GND1	GND1	GND			GND	GND1	GND1	GND1
G	GND1	GND1	GND1	GND			GND	GND	GND	GND
F		RX2	GND1		GND	GND		GND		RN
E	GND1	GND1	GND1	ADR0	ADR1			GND	SD	
D	GND	GND							SENS	RP
C	VCC3	VCC3	N.C.	N.C.	N.C.	VCC2	N.C.	VCC1	N.C.	N.C.
B	SEB	SCLK	MISO	SCANB	IF2	IF2x	IF1x	IF3	TIN	TINx
A	GND		MOSI	RSETB		IF1		IF3x		GND



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MRD2001: 77 GHz Radar Transceiver Chipset

Features	Benefits
Scalable to 4 TX channels and 12 RX channels	Enables single radar platform with electronic beam steering over wide field-of-view supporting long range, mid-range, and short-range radar applications for budget to luxury vehicles.
Integrated RX BB filter and VGA	Saves system BOM cost.
Optimized for Freescale Radar Processor MPC577xK	Receiver path optimization with MPC577xK including unique built-in system test features ensures the best receiver sensitivity required for excellent detection accuracy.
Advanced packaging technology	Easiest to use, handle, and manufacture for customers. Ensures highest performance and minimum signal interference on the customer PCB.
Low power consumption 2.5 W for the total transceiver *Best phase noise < -85 dBc/Hz at 100 kHz offset*	Low power consumption saves energy and heat. Best phase noise enables precise discrimination of objects for automatic cruise control, blind spot detection, lane departure warning, and pedestrian detection.

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Qorivva MPC577xK MCU

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Delivering industry leading levels of performance and integration needed for highly-complex radar applications

Optimal Integration

Right balance of feature integration drives miniaturization of package size and lowers overall BOM cost

Top Performance

MPC577xK offers top-performance for intense computational tasks with key integrated digital accelerators

Proven Safe Technology

Built on proven, safe technology – the MPC577xK delivers a scalable, well documented, process-compliant safe architecture along with safety software and part of the SafeAssure program

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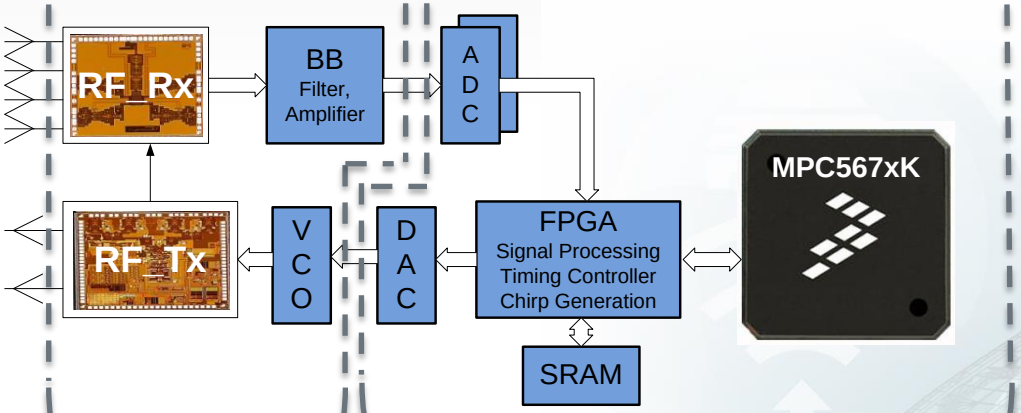
77Ghz Radar System

Previous Generation vs Next Generation



Previous Generation

Next Generation

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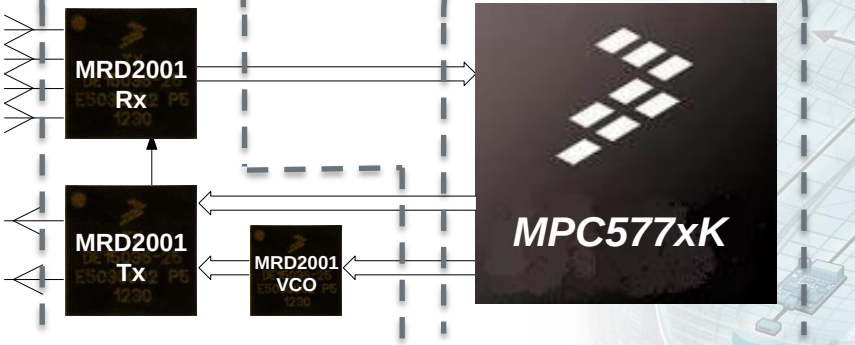

Qorivva MPC577xK

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  - General purpose MCU
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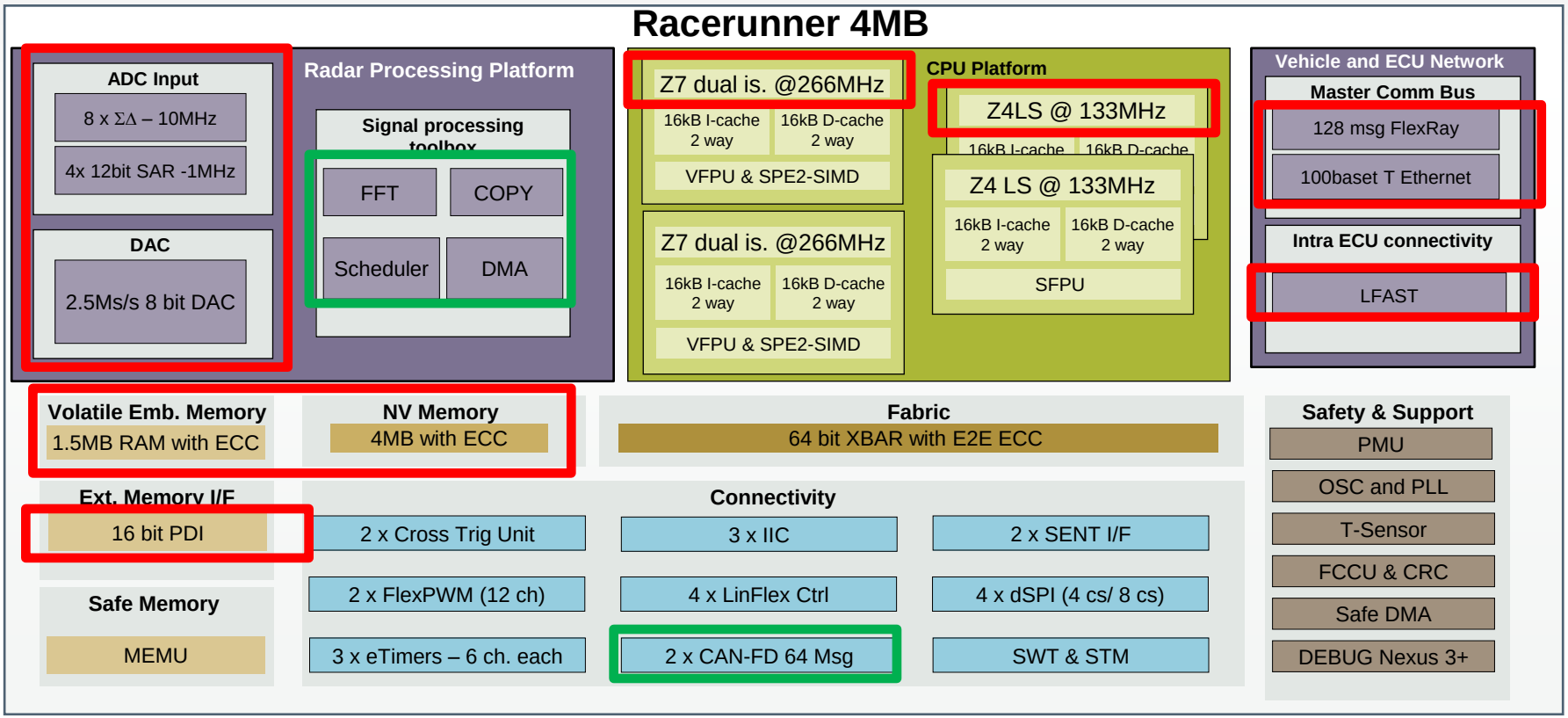
Racerunner 2x Z7 + 2x Z4LS – 4 MByte Si available



Specifications:

- **CPU: 3x PPC: 2x Z7** 266 MHz Power dual issue with SPE2 and VFPU and Z4 133MHz in permanent lockstep
- **SPT:** FFT Accelerator, DMA
- **Analog:** Octal SD + 4 SAR, Ultra low jitter PLL, precision DAC
- **Package:** 356 PBGA – 0.8 mm pitch – 17 x 17 mm^2 body
- **Temp Range (Ta):** -40 to 125°C, 150 °C Tj, AEC-Q100 Grade 1
- **Main Supply:** 3.3V IO (5V SAR) and 1.2V Core (ext or PMU)

Key Features:

- **F. Safety:** developed as per ISO26262 with target ASIL-D
- **Safety Enablement:** Safety Manual and FMEDA
- **SPT:** Radix4/2, r2c, c2c, 50 MHz 16 bit twiddle, 24 bit results, Copy, Transpose
- **SRAM:** Multi ported SRAM Ctrl and 1.5MB SRAM with ECC
- **Top of Class Analogue IP:** PLL, DAC, OSC and ΣΔ ADC
- **SW Enablement:** QMS MCAL and/or Safe Mcal Asil B (D)

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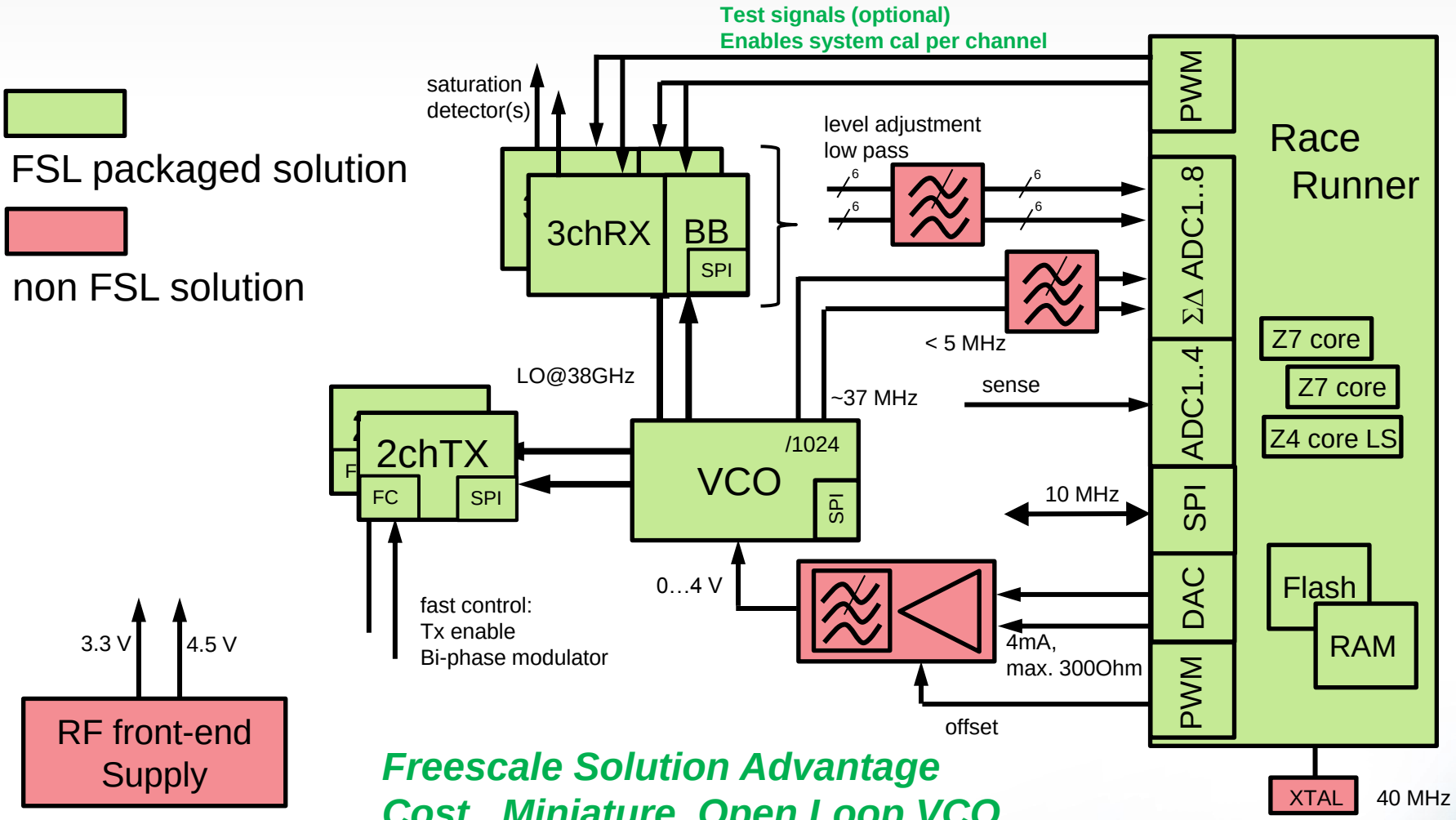
Freescale 77Ghz Radar System Solution



Freescale Solution Advantage
Cost , Miniature, Open Loop VCO
ISO26262,

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Summary

- Freescale introduces the industry's most complete system-level ADAS solution for automotive radar
  - Qorivva MPC577xK MCU family: industry-leading performance and integration for highly-complex radar applications
  - MRD2001 77 GHz radar transceiver chipset: high-performance and scalable for transmitting and receiving multiple channels
- This system-level radar solution will help reduce BOM cost and PCB footprint – bringing ADAS solutions into mainstream vehicles
- Freescale addresses upcoming legislation and safety program needs to reduce the rising trends of vehicle fatalities and opens the road to self-driving vehicles of the future

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