77GHZ毫米波雷达国产化纪要

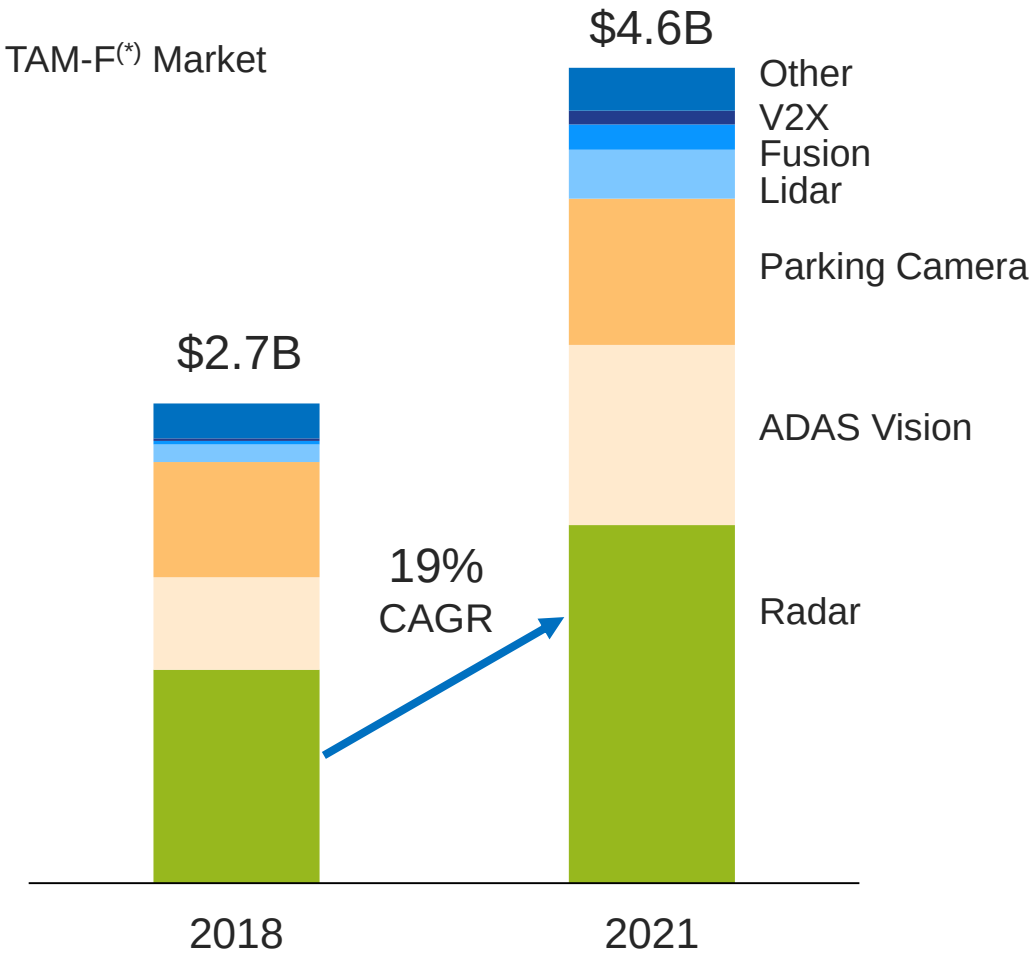
杨昌
产品市场经理，毫米波雷达&V2X，大中华区

DEC 2020

SECURE CONNECTIONS
FOR A SMARTER WORLD

PUBLIC

RADAR: LARGEST ADAS SEGMENT WITH TOP GROWTH CONTRIBUTION



Radar

- Represents >44% of ADAS TAM-F
- NCAP Safety Ratings drive Radar penetration
- 360° view & Imaging Radar drive Semi $

Other ADAS

- ADAS Vision is NCAP driven
- Parking cameras maturing, limited growth
- Fusion & Lidar of limited impact in mid term
- V2X driven by mass roll out of committed top OEMs: VW from 2019, Toyota & GM follow

Source: IHS Markit, Strategy Analytics, NXP
(*) TAM-F: TAM – Memory – Discrete – Opto

CHINA AUTOMOTIVE MARKET POTENTIAL

Growth Potential

Up to 60+M radar modules **by Local T1s** by 2029

Main growth engines

Regional take-over

- **GC PV:** GC OEMs start to utilize **GC Tier 1** Radar for AEB, FCW, BSD.

- **SGMW:** MRR by a GC Tier 1. More car model: Hongguang, Baojun will choose GC Tier 1.

- **Chery**: MRR & SRR by a GC Tier 1. More car model will choose GC Tier 1.

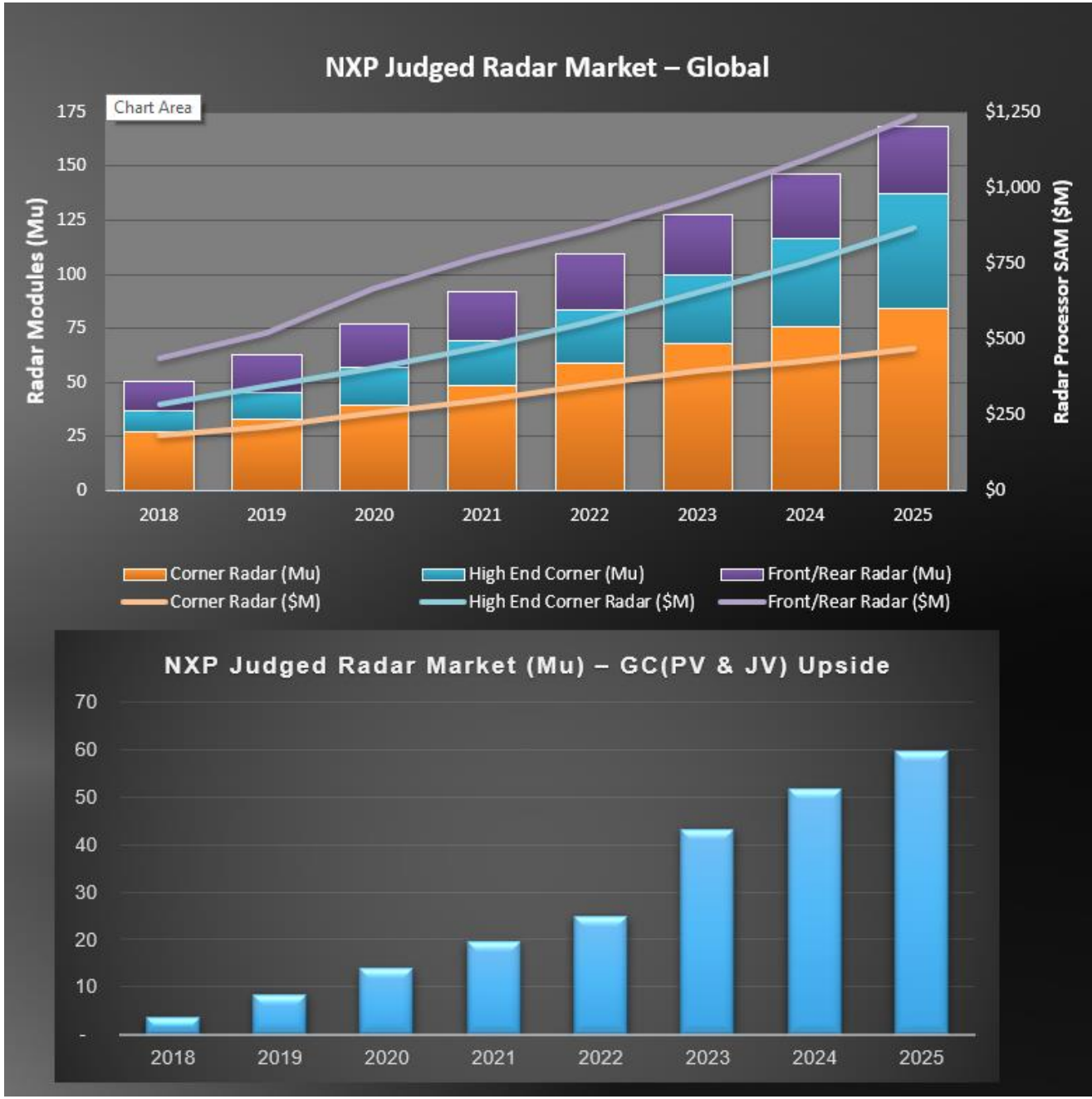
- **Changan**: SRR by a GC Tier 1.

- **FAW**: SRR by a GC Tier 1.
- More OEMs will choose GC Tier 1 in 2021…

- **GC CV:** Regulation JT/T 1178.1 brings **1.34Mu MRR** and **2.6Mu SRR** market per year

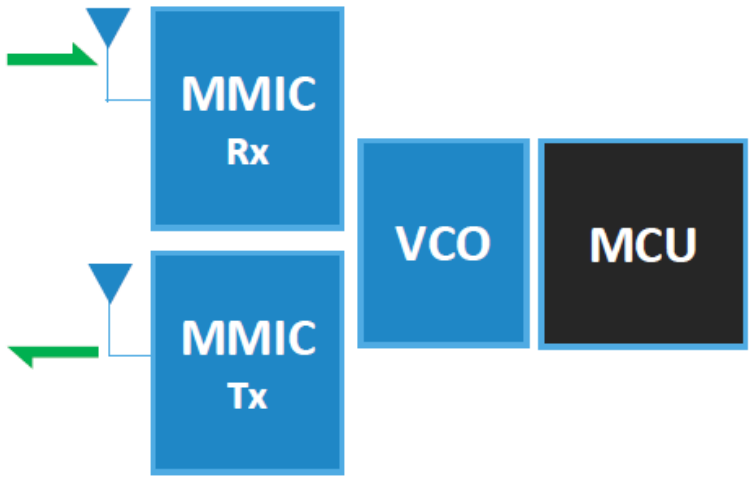
- **FAW JF:** MRR & SRR by a GC Tier 1

- **ZQ:** MRR & SRR by a GC Tier 1
- **SXQC:** MRR & SRR by a GC Tier 1
- SRR will be introduced for low-light scenario...

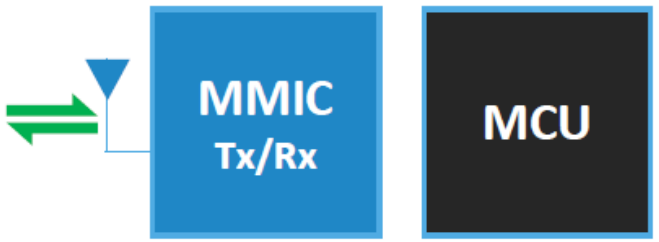


RADAR SENSOR EVOLUTION

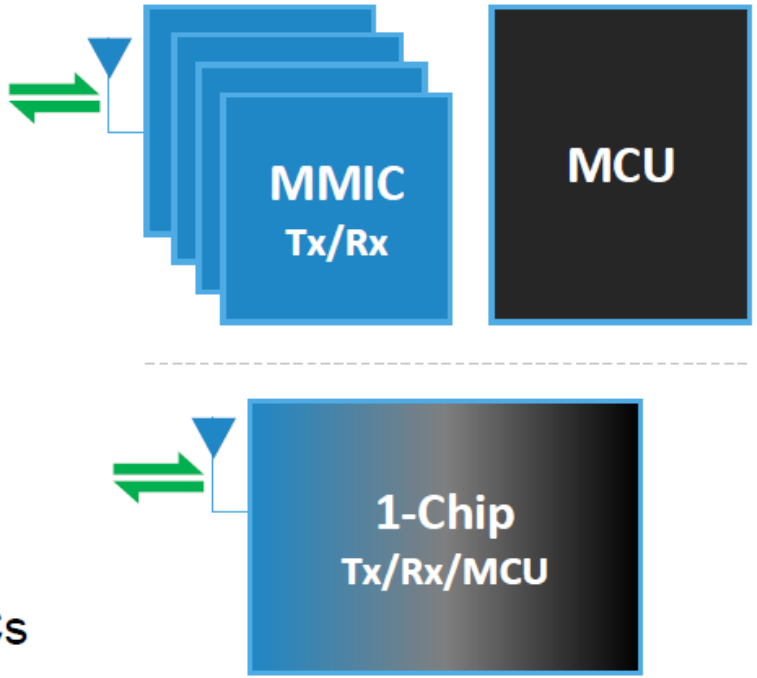
Yesterday's Systems



Current Systems



Future Systems



- Significantly small & low-power sensors through RFCMOS integrated MMICs
- Scalable transceivers for future high-performance cascading requirements
- Highly integrated single chip Radar SoCs for cost/footprint sensitive segments

DOLPHIN ONE PAGE

TEF810X 毫米波雷达收发芯片

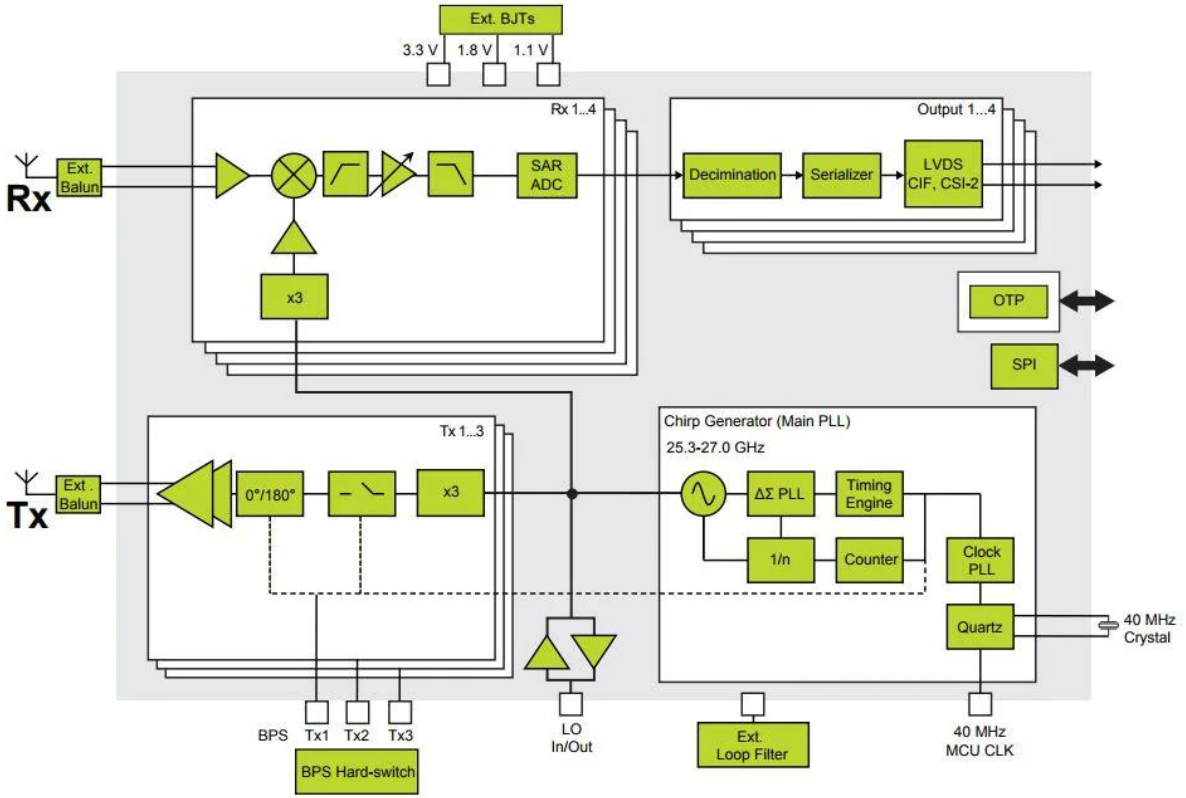
TEF810X 是一款高度集成的汽车FMCW雷达芯片。

支持76-81GHz的工作频段，覆盖了汽车毫米波雷达应用的全频带。收发芯片包含了3路发射，4路接收，ADC内置采样及低噪声VCO。芯片同时内置多种安全监测模块并支持MIPI-CSI和LVDS数据传输接口。

- 基于高度集成的RFCMOS工艺
- 兼容ISO26262， ASIL B 等级
- 优化的快速扫频调制
- 支持汽车级温度范围（-40℃到135℃）
- 高度兼容NXP S32R 系列雷达处理器

通道数	3TX(W/BPSK) & 4RX	级联支持	4 chips for up to 12TX and 16RX with Master Device
频率范围	76-81GHz	封装	155 pin eWLB 7.5x7.5 mm
输出功率	12dBm Typ (76-78 GHz) 11dBm Typ (78-81 GHz)	ADC 采样率	20MS/s
噪声系数	12dBm Typ (76-77 GHz) 13dBm Typ (77-81 GHz)	接口	CSI-2 & LVDS
相位噪声	-90dBc/Hz Typ 0.5GHz chirp (76-77GHz)	温度范围	-40 to 135 ℃ Tj
功耗	1.2W Typical（2TX 50%）	扫频带宽	2GHz

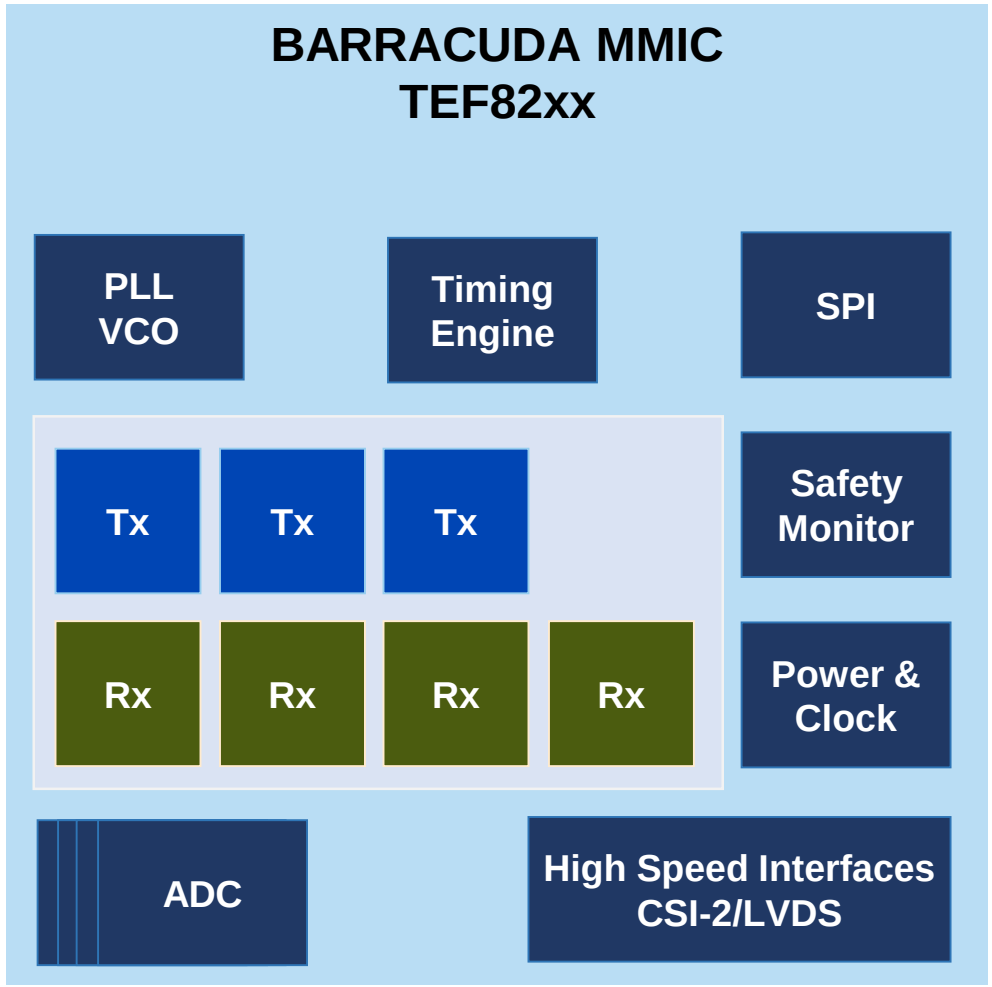
TEF810X BLOCK DIAGRAM



目标应用场景：

- 自适应巡航(ACC)
- 自动紧急刹车控制(AEB)
- 盲点检测(BSD)
- 变道辅助(LCA)
- 停车辅助(PA)
- 后侧横向来车警告(RCTA)
- 前侧横向来车警告(FCTA)
- 后侧碰撞避免(RCA)
- 茧式雷达
- 成像雷达

BARRACUDA
TEF82XX



Scalable 2nd Generation RFCMOS 77GHz Radar Transceiver

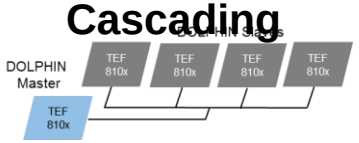
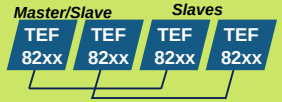
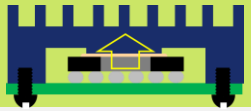
Key Features:

- **3 T**ransmit and **4 R**eceive Channels
- **6-bit** Phase Rotator
- Simplified cascading for **Imaging Radar**
- Excellent Thermal Performance: **R_{th} ~6K/W**
- Scalable **Chirp Bandwidth**: up to **4 GHz**
- Improved **RF Performance: Pout ~10.5dBm, NF ~13.5dB**
- Enhanced **IF Bandwidth: 20 MHz**
- Small footprint: eWLB **Exposed Die package**(7.5mmx7.5mm)

Applications:

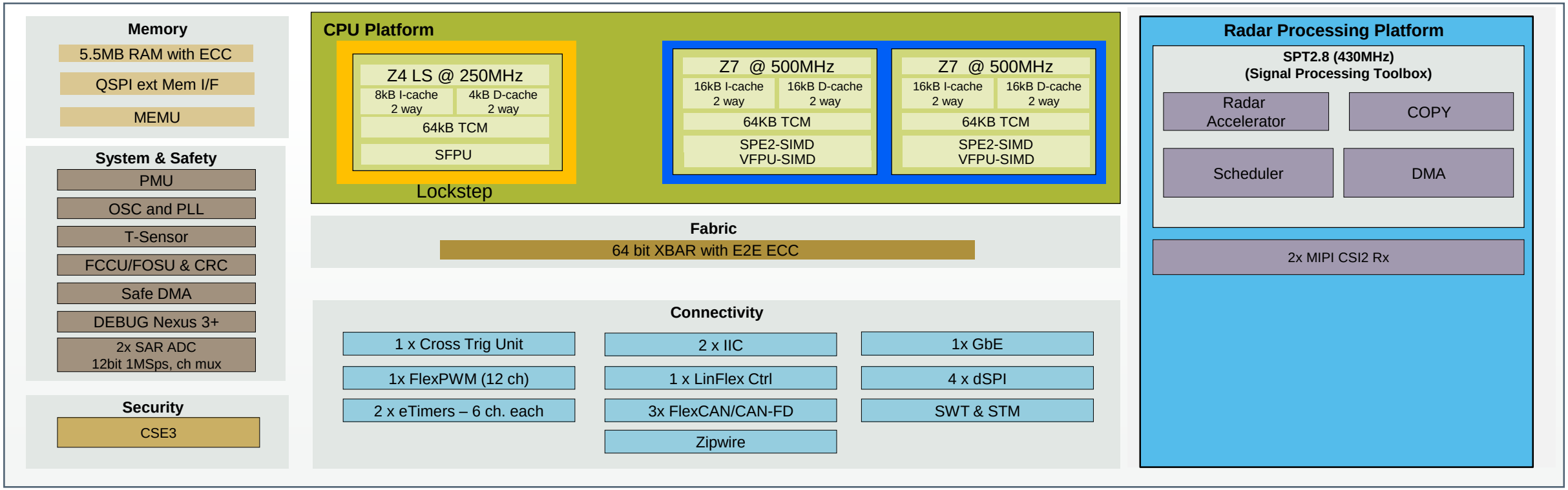
- **Automotive Radar:** AEB, ACC, BSD, LCA, FCTA
- **Segments:** Low to High

BARRACUDA KEY ENHANCEMENTS

	DOLPHIN	BARRACUDA	
IF Bandwidth ADC Sample Rate	10 MHz 20 MS/s*	20 MHz 40 MS/s*	Higher Distance Resolution
Chirp Bandwidth	2+2 GHz	4 GHz	
Phase Noise	-86dBc/Hz @1MHz (76/77GHz)	-92dBc/Hz	Better Object Separation
Phase Rotator	1 bit	6 bit	Enhanced MIMO (CDMA)
Noise Figure	14dB/15dB	13.5dB/14dB	Enhanced sensitivity
Power Output	10dBm @77GHz 8.6dBm @79GHz 7dBm @81GHz	10.5dBm @77GHz 9.5dBm @79GHz 8dBm @81GHz	
Cascading 	Combined LO in/out	Separate LO in/out 	Enhanced Imaging Radar
Thermal Performance 	Ta 115 C Tj 135 C Rth ~18 K/W	Ta 125 C; Tj 135 C Rth ~6 K/W 	Operation over full Automotive Temp Range

*ADC sampling rate after decimation

S32R29X ARCHITECTURE AND BENEFITS



Specifications:

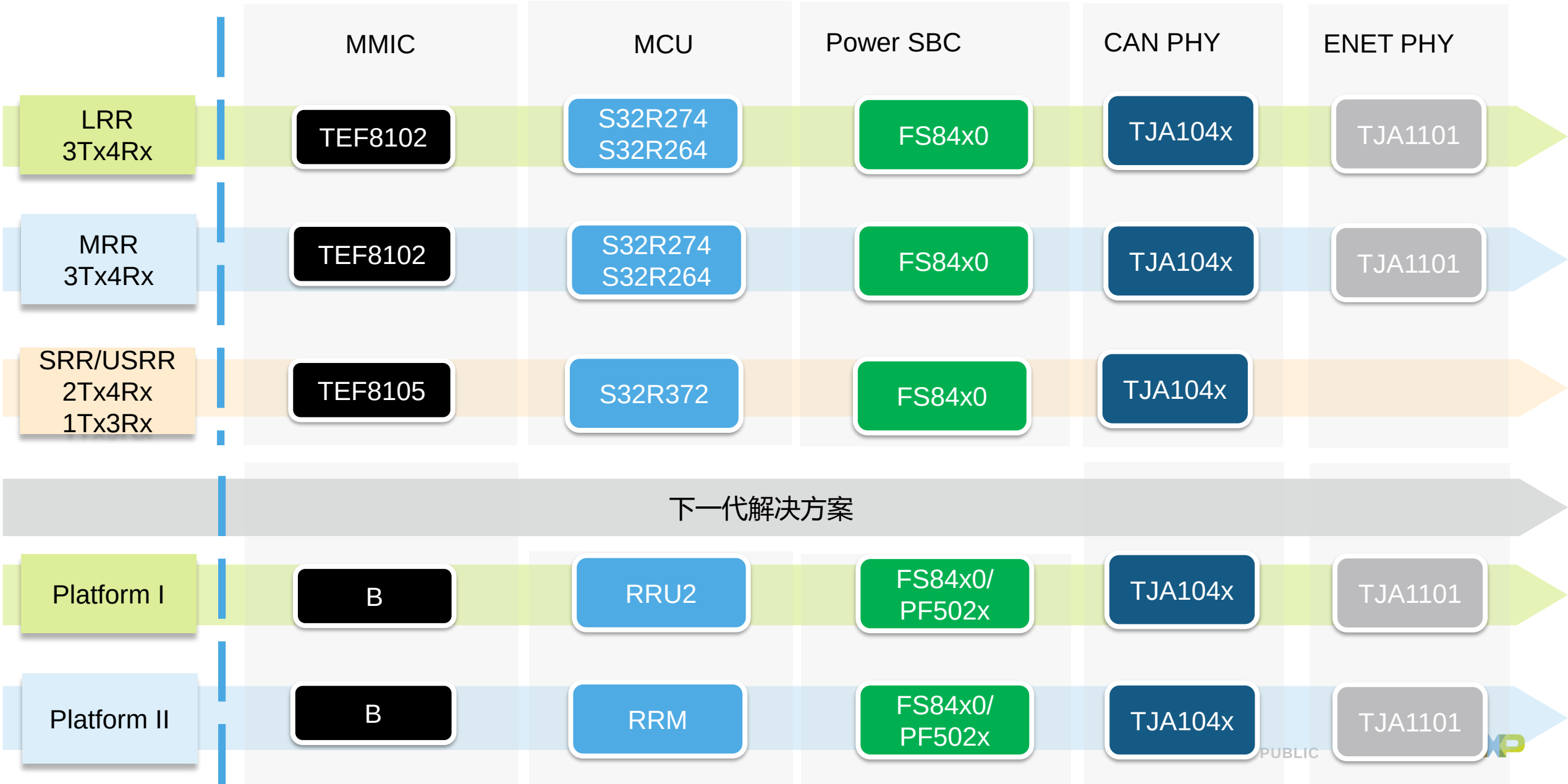
- **CPU:** 2xZ7 500Hz (w/ SPE2) & 1x LS Z4 250MHz
- **SPT 2.8:** Radar Signal Processing Accelerator, DMA
- **Analog:** 2x SAR ADC's
- **Package:** 269 MAPBGA (14x14mm^2, 0.8mm pitch)
- **Temp Range (Ta):** -40 to 125°C (150°C Tj), AEC-Q100 Grade 1
- **Main Supply:** 3.3V, 1.8V & 0.8V (ext)

Benefits:

* Full featured configuration shown

- **Functional Safety:** as per ISO 26262 with target ASIL D
- **Security:** CSE3
- **SPT:** Radar acceleration mathematical functions
- **Memory:** Up to 5.5MB SRAM (w/ ECC)
- **SW Enablement:** Radar SDK, Safe AUTOSAR MCAL ASIL B (D), SCST, freeRTOS, non-AutoSAR Driver SDK, TCP/IP Stacks,S32 Design Studio and CSE3 Security Firmware

NXP PROVIDES FULL PRODUCTS PORTFOLIO



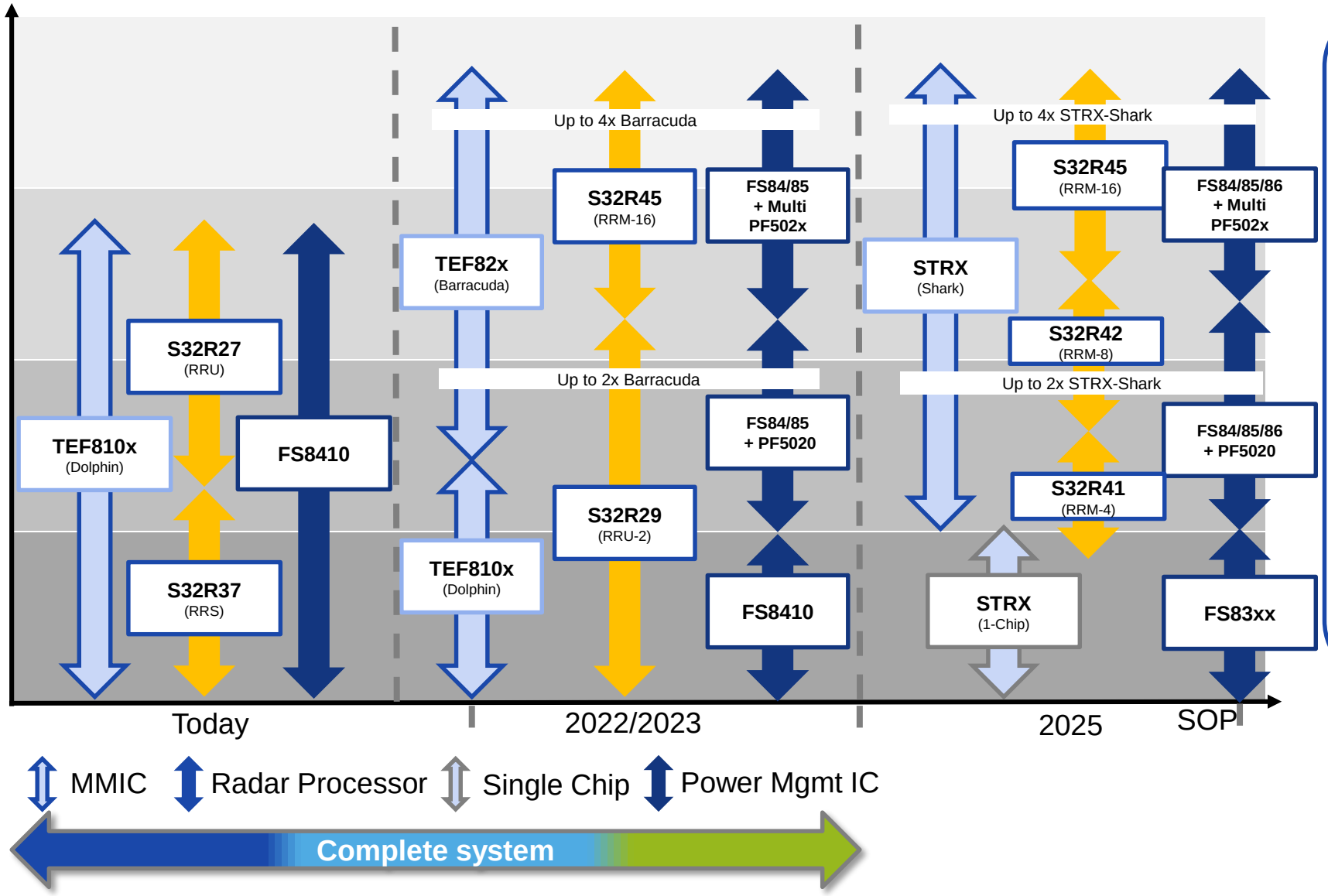
NXP RADAR SOLUTIONS: FUTURE PROOFED, SCALABLE PERFORMANCE

Front Radar High:
Highway Pilot 2.0

Front Radar:
Highway Chauffeur (L3), ACC, AEB,

High End Corner:
Front Cross Traffic Alert, AEB w/ pedestrians

Corner Radar:
LCA, Cross traffic Alert Blind Spot Detection



- End to End radar solution
- Future proofed, Scalable Performance
- Market leading Performance Per Watt w/ SPT
- System functional safety

Radar webpage:

https://www.nxp.com.cn/applications/solutions/automotive/adas-and-highly-automated-driving/automotive-radar-systems:RADAR-SYSTEMS?tid=FSHBNRZH_20200602&cid=IB_PRG338840_TAC379443

Radar HW:

https://www.nxp.com.cn/design/development-boards/automotive-development-platforms/s32r-mcu-platforms/s32r274-end-to-end-reference-design-kit:RDK-S32R274

Radar SDK & MATLAB Toolbox:

https://www.nxp.com/products/processors-and-microcontrollers/power-architecture/s32r-radar-mcus/s32r26-and-s32r27-microcontrollers-for-high-performance-radar:S32R2X?tab=Design_Tools_Tab

Radar community:

https://community.nxp.com/community/mbdt/mbdt-for-radar

SECURE CONNECTIONS
FOR A SMARTER WORLD