



Infineon 77GHz Imaging Radar Solutions

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Radar and ADAS Domain Applications
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SAE ADAS / AD Levels – where is 77GHz Imaging Radar needed?

SAE ADAS/AD Level	Definition	Use case example
L5	Autonomous driving without limited ODD*	Robotaxis (worldwide)
L4	Autonomous driving in specified ODD* Driving function not overtaken by driver	Robotaxis (limited area)
L3	Autonomous driving with limited ODD* Driver is required to take over	Traffic jam pilot
L2+	L2 with wider ODD*	Lane centering and Auto Cruise Control
L2	Steering support and velocity control support	Lane centering and Auto Cruise Control
L1	Steering support or velocity control support	Lane centering or Auto Cruise Control
L0	AEB function	Auto Emergency braking

*ODD = Operational Design Domain, which refers to the set of driving conditions such as weather, geography, time of day, traffic and road conditions.

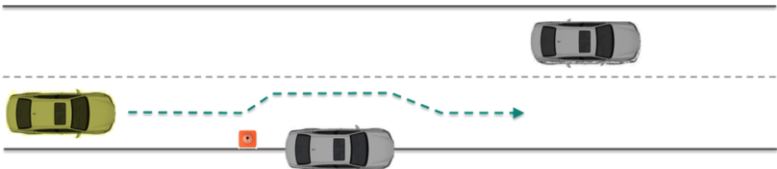
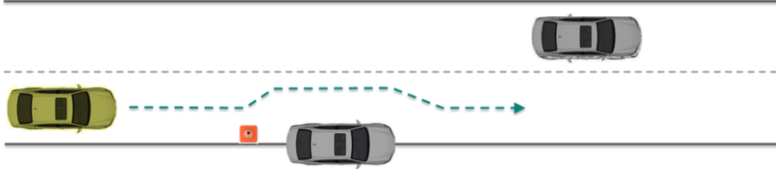
Infineon Definitions

HD Imaging Radar
≥ 16T16R

4D Imaging Radar
8T8R – 12T12R

Standard Radar
≤ 4T4R

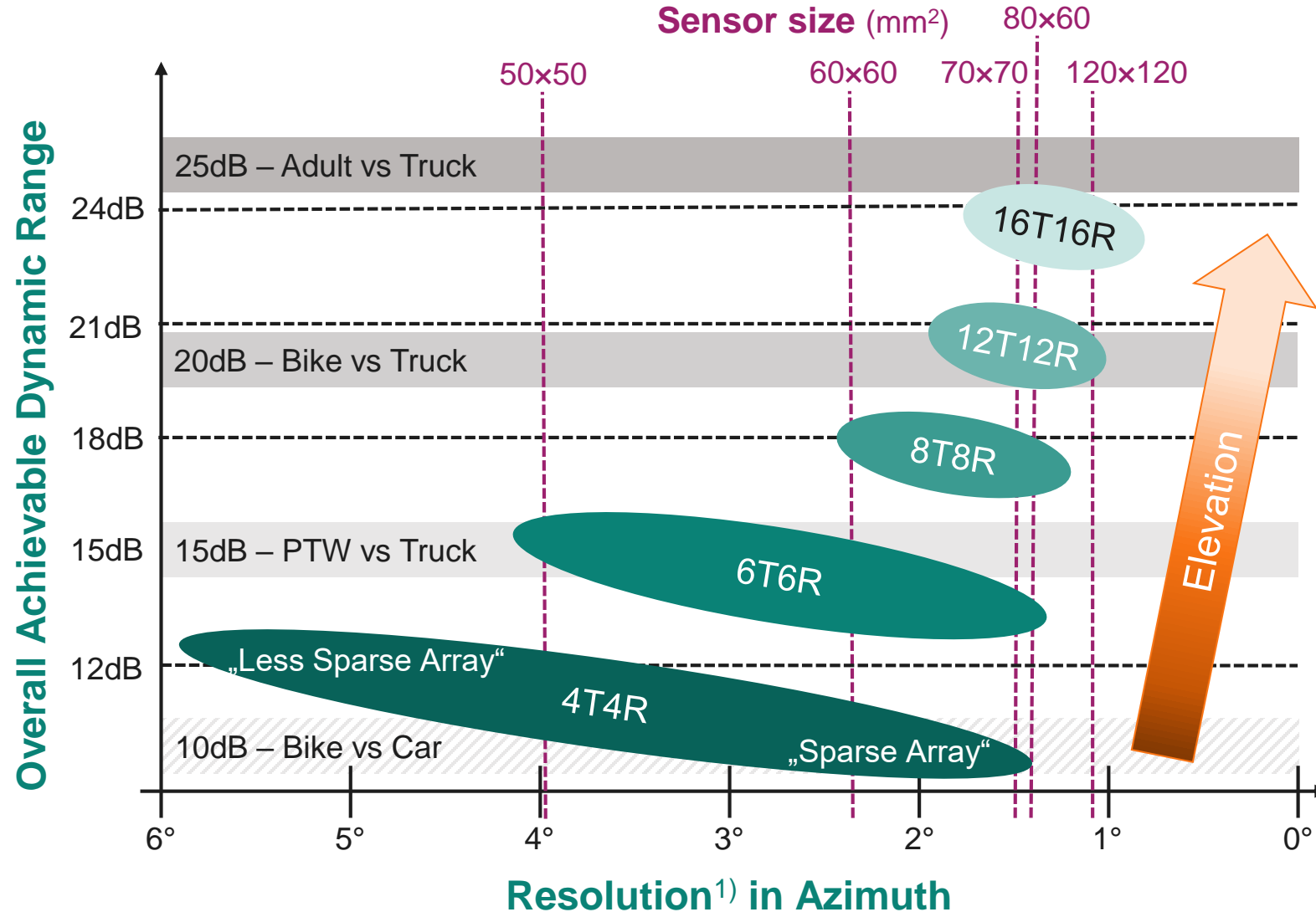
Different driving expectations between L2+ and L3/L4 needs different sensor configuration and much better performance

Vehicle confronted with stalled vehicle on the side of the lane and vehicle on adjacent lane			
		L2+	
		Ego car should stop	
Azimuth angular resolution	1° (3m @ 200m distance)		
Virtual channel number	< 256 (8x8 – 16x16)		
Number of detections	< 2000		
Cost / performance optimization -> 4D Imaging			
			
		L3/L4	
		Ego car should maneuver	
		0.3° (1m @ 200m distance)	
		typ. > 1000 (e.g. 24 x 24 = 576, up to 48x48 = 2304)	
		> 2000	
		Massive improved sensor -> HD Imaging	

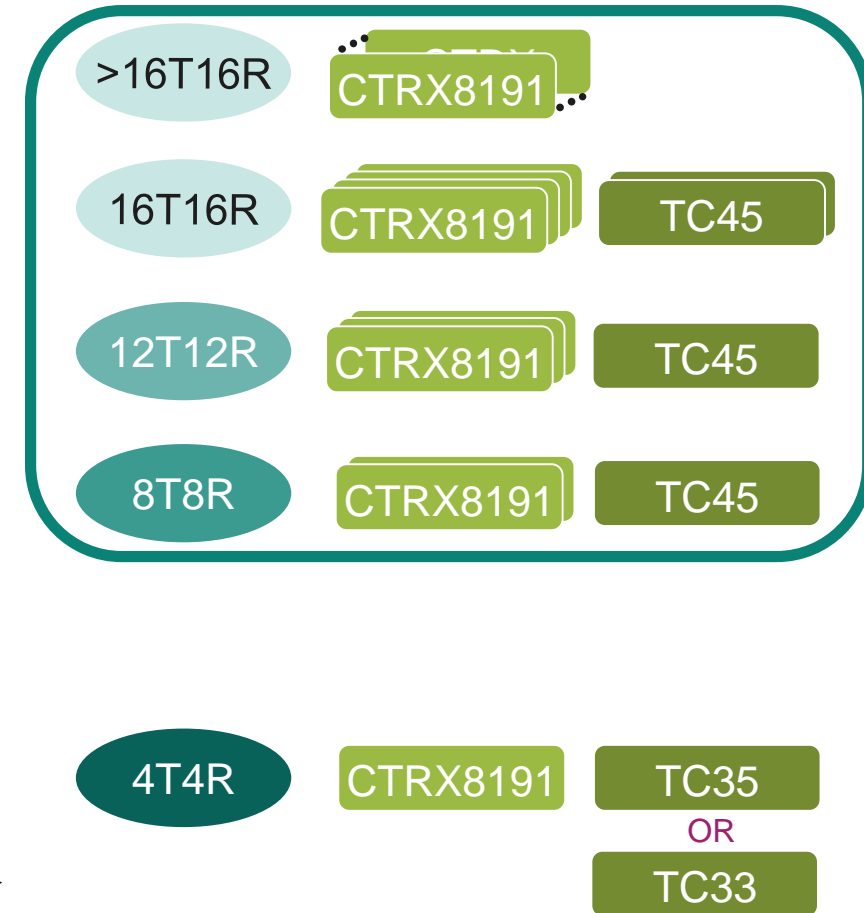
From L3 onwards increase performance is paramount

Separability drives Dynamic Range, Azimuth & Elevation resolution

Infineon's radar solution scales RF channels to match separability needs.



Imaging Radar



¹⁾ high-resolution algorithms not included

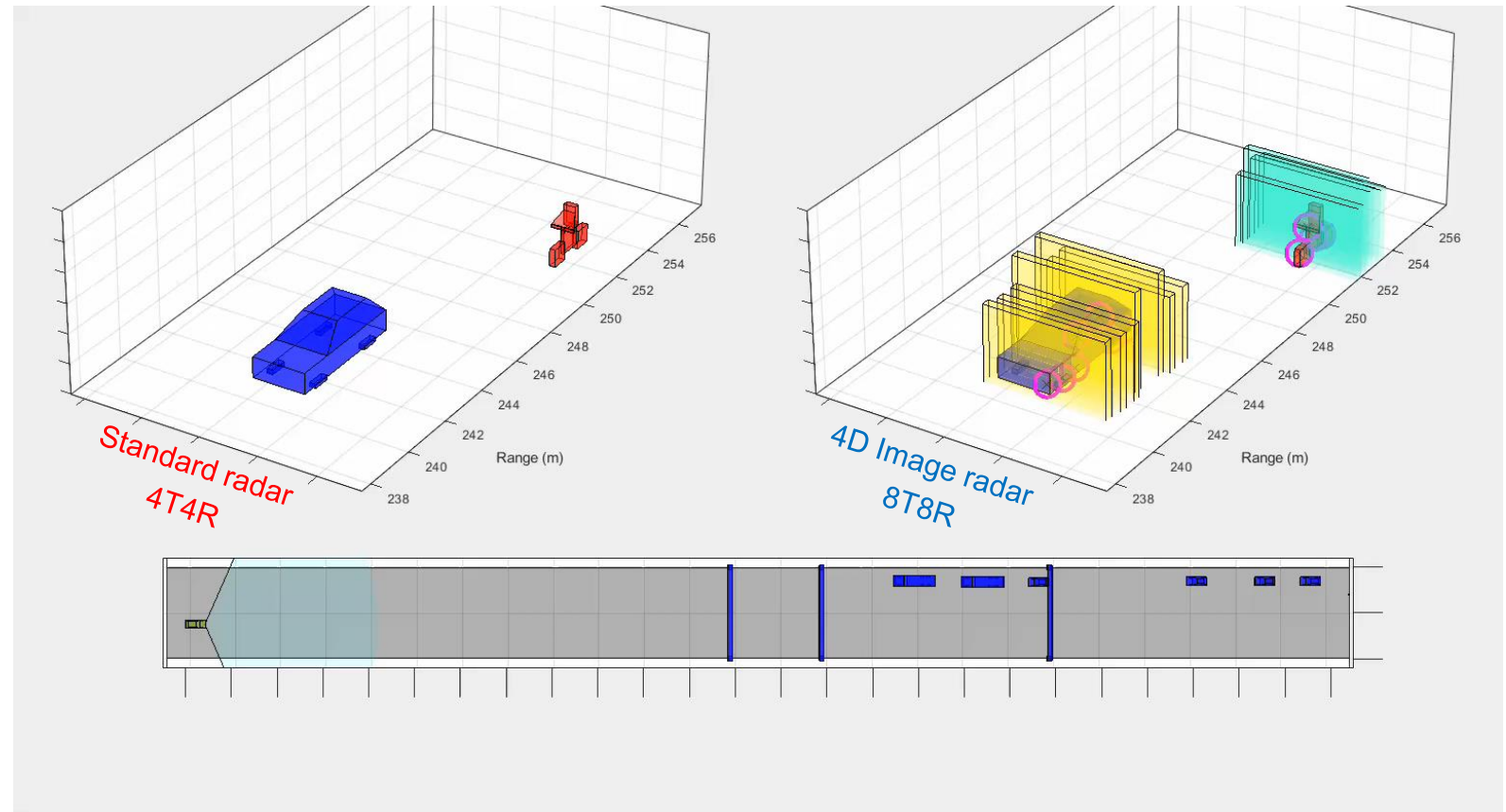
8T8R CTRX8191F enables 4D and HD Imaging Radar Solutions with excellent RF Performance and low-cost RF Laminates.

First 8T8R Antenna Feed-in-Package cascading

Excellent detection range: > 250 m

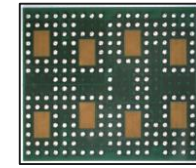
Excellent azimuth angular performance with elevation angle estimation

Premium software packages and CarKit soon available to support Fast Time to Market



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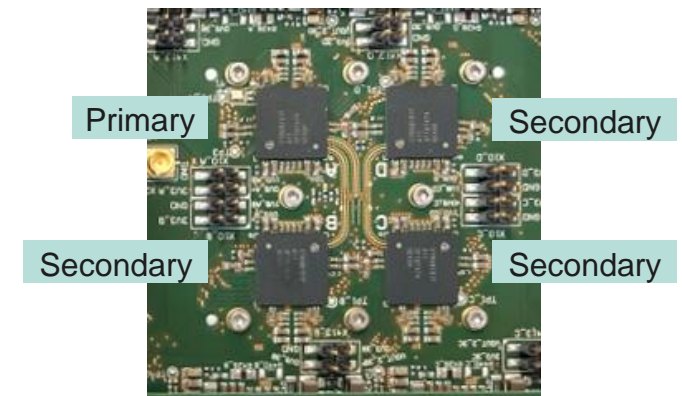
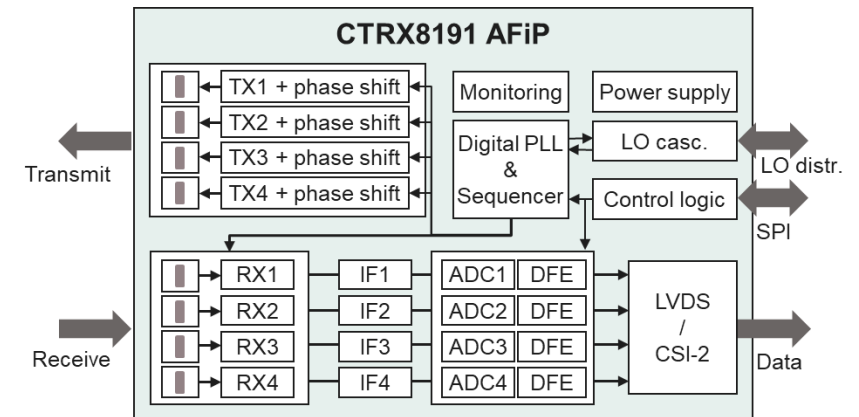
CTRX8191F enables cascaded 4D/HD Imaging Radar solutions with excellent RF performance and low-cost RF PCB's.



Future-proof performance and flexibility to cope with future automotive radar needs.

CTRX8191F key characteristics:

- 4 Transmitters + 4 Receivers
- Digital PLL enables situation based **on-the fly modulation adaption**, e.g. from **highway** (high speed) to **parking** (high resolution)
- **Cascading** via 26GHz LO self-feeding ports (1x LO_{OUT}, 2x LO_{IN}) allows low-cost substrates and symmetrical designs for fast TTM
- Antenna-Feed-in-Package (AFiP) for **lower system cost** and **larger system link budget**
- **MMIC platform approach** enables scalable Imaging Radar segments from 8T8R up to 40T40R

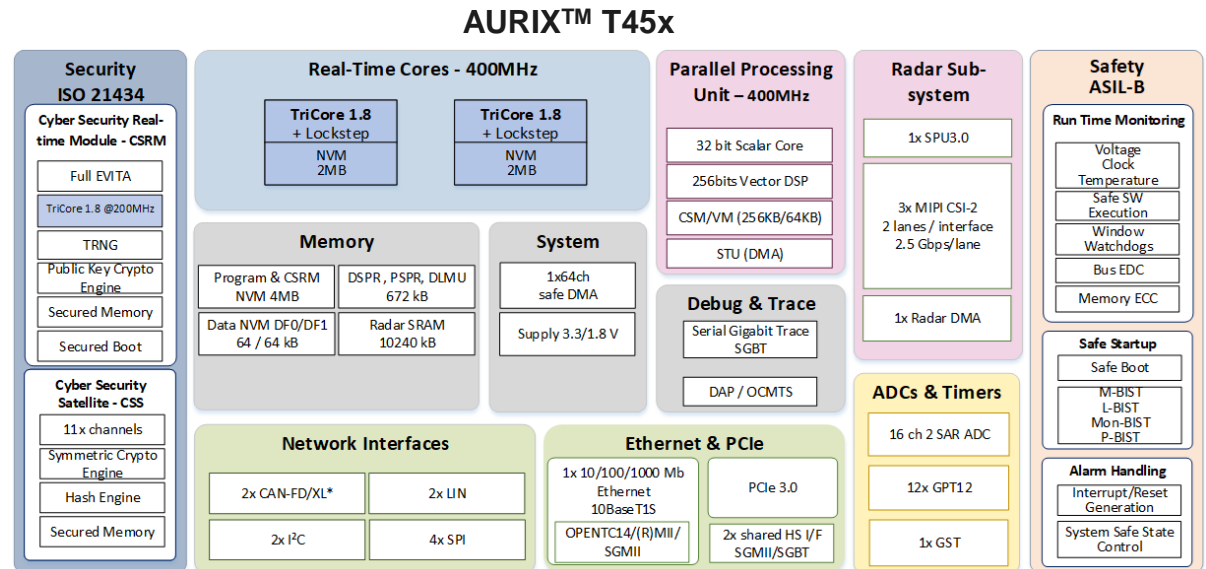


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AURIX™ TC45x enables 4D imaging Radar solution by offering Scalability, Large internal SRAM and Efficient Radar Processing



- Monolithic MCU with **integrated SRAM** and **NVM**
 - Embedded **10MB** SRAM and **4MB** NVM hence no external memory needed
- Dedicated **Radar Direct Memory Access (DMA)**
 - Reduced Latencies up to **400MBins/s** for **fast data transfer** from and to Radar SRAM with large bandwidth
- **Signal Processing Unit (SPU3.0)** for radar **pre-processing**
 - Up to **800Msamples/s** sampling rate with **interference detection, mitigation / repair** functionality
- **Parallel Processing Unit (PPU)** with **Scalar Core + SIMD Vector DSP** for **linear algebra acceleration** and post-processing
 - acceleration of **matrix & vector** operations with up to **77GOPS** + **800 DMIPs ASIL-B** for radar signal post processing functions
- **PCIe** enables cascading of **2xTC45** for higher channel Radar system
 - Achieve high performance **16x16** and **24x24** radar system using 2xTC45x



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From 8T8R to 24T24R and beyond

CTRX8191F + AURIX™ TC45: Powering imaging radars



Cost efficient

No RF substrates
No external memory
No external buffers



Performance

Better **object separability**
Higher **resolution**
Larger **range/field-of-view**



Scalability

Reuse **software**
Reuse **hardware**
Scalable systems



AFiP package
Large LO link budget
(16dB)



Integrated NVM (4MB)
Integrated SRAM (10MB)



Fully flexible sequencer
Fast flyback (1us)
Linearity (P1dB: -0.5dBm)



SPU3.0
PPU with vector DSP
Radar DMA

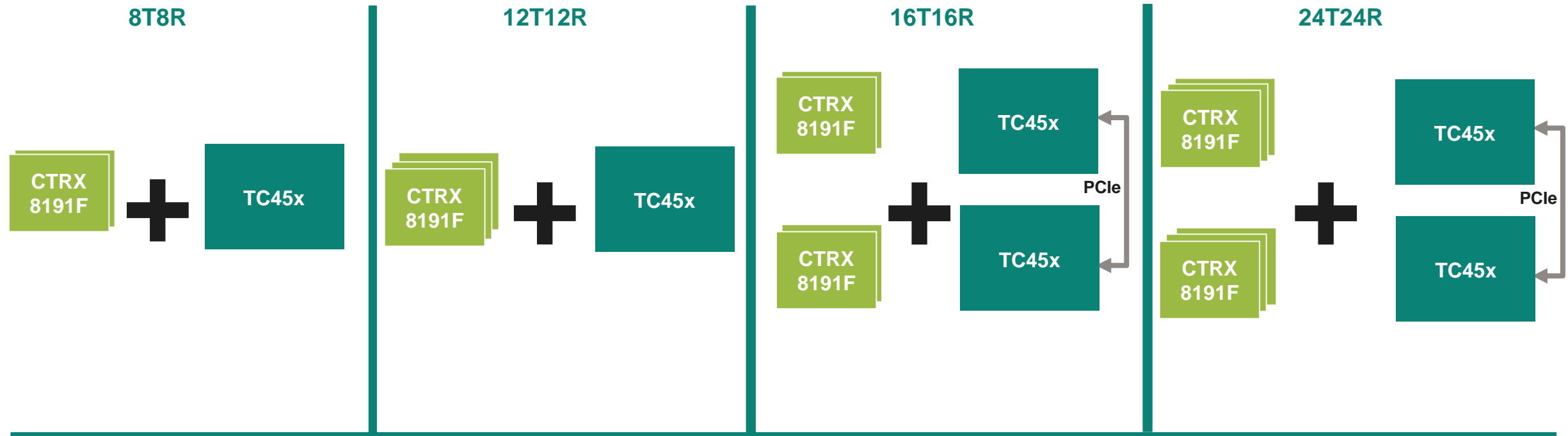


Cascading
Large LO link budget
(16dB)



PCIe for combining
2x TC45

AURIX™ TC45x provides a cost effective and optimized feature set for cascading up to 6x CTRX8191F



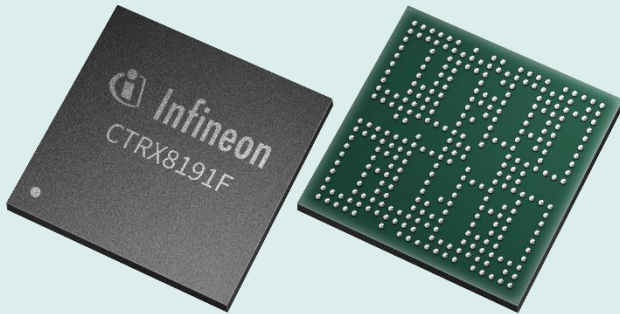
- 1x TC45x with **10MB Radar SRAM** is **optimized** for 8T8R and 12T12R use cases
- **Cascade 2x TC45x** using **PCIe** for 16T16R and 24T24R
- **2x TC45x** cascade will work over the specified **temperature range** i.e., -40° to 150°C
- Using **2x TC45x** provides combined **20MB SRAM**, **2x SPU3.0**, **2x PPU** for more processing performance
- **PCIe** makes **shared SRAM** between cascaded controllers **transparent**.

Speed up development time

Infineon offers multiple ways to evaluate CTRX

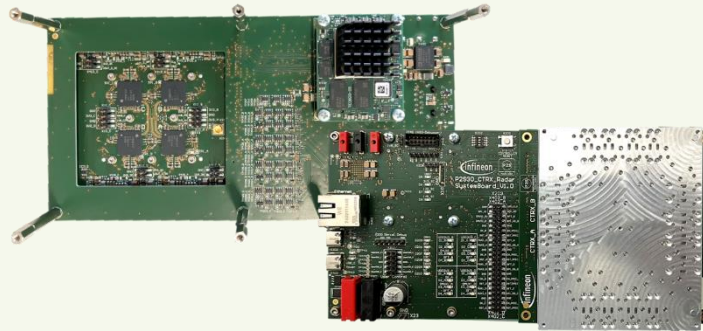
CTRX8191F samples

For module development



CTRX P2S board

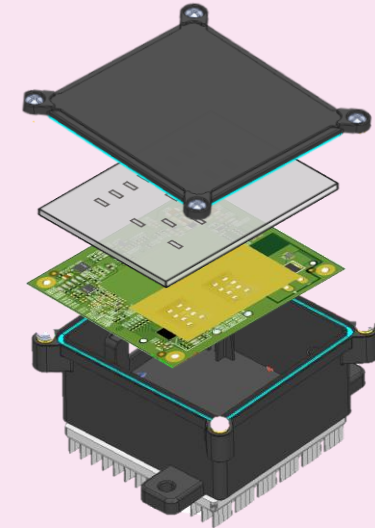
Full CTRX measurement capabilities



- CTRX performance reference

CARKIT

Full module for initial data collection & accelerating module development



- Reference design with schematics, layout, BOM, etc

Infineon = trusted partner for 77GHz automotive Radar

— QUALITY LEADER —



Zero Defect is part of our DNA. Infineons products are designed with **reliability** and **manufacturability** in mind → ensuring high product quality at lowest dpm level resulting in **reliable radar sensors**.

— PERFORMANCE FIT —



Infineon offering **longest range, widest field-of-view, and most robust radar sensors** thanks to best-in-class RF & compute performance.

— BROAD PORTFOLIO —



Infineon covers all radar sensor segments – from standard NCAP radar sensor to Base Corner to High resolution radars - **and across all architectures** – from Full-processing to Pre-processing to Raw-data streaming

— MOST EXPERIENCED —



Infineon is the industry's radar gold standard for 77GHz: **More than 15 years of Radar experience with >300Mpcs RASIC™ MMICs and >200Mpcs AURIX™ micro-controllers on the road.**

