

# AUTOMOTIVE RADAR TEACH-IN

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SECURE CONNECTIONS  
FOR A SMARTER WORLD

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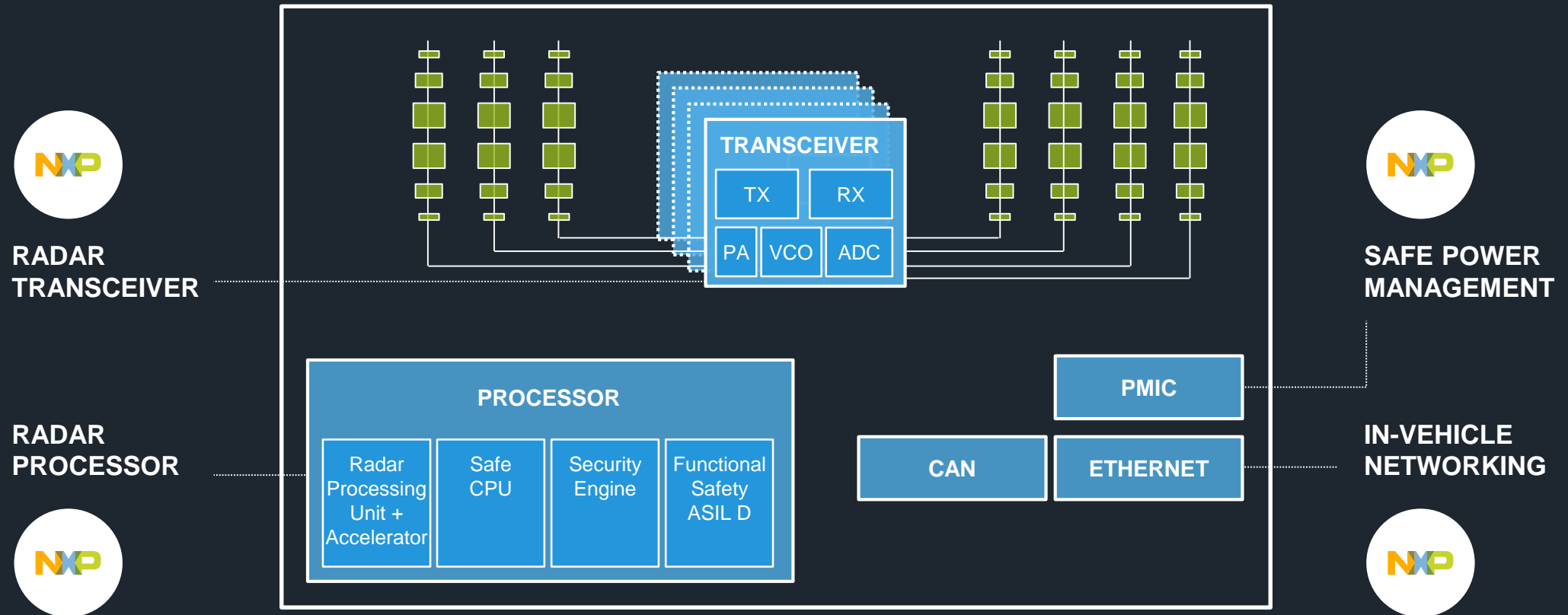
# RADAR SYSTEMS: AVOIDING ACCIDENTS AND SAVING LIVES



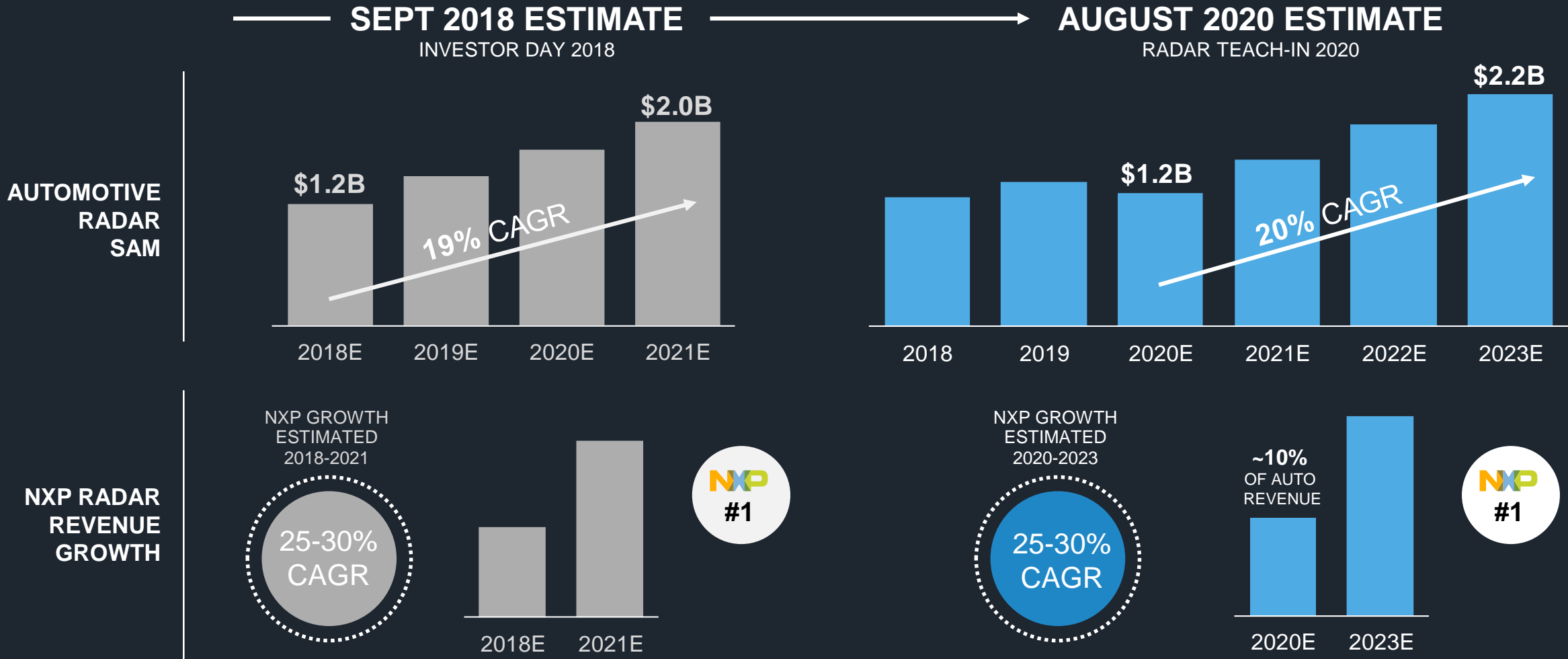
# WHAT IS A RADAR NODE – NXP'S SYSTEM VIEW

## RADAR NODE

COMPLETE AUTOMOTIVE SYSTEM SOLUTION FROM NXP



# RECONFIRMING ATTRACTIVENESS OF THE AUTOMOTIVE RADAR MARKET OPPORTUNITY





# DRIVER SAFETY LEVELS ARE INCREASING OVER TIME; NEW LEVEL 2+ EMERGING

**LEVEL 1**  
DRIVER ASSISTANCE

**LEVEL 2**  
PARTIAL AUTOMATION

**LEVEL 2+ TO 3**  
CONDITIONAL AUTOMATION

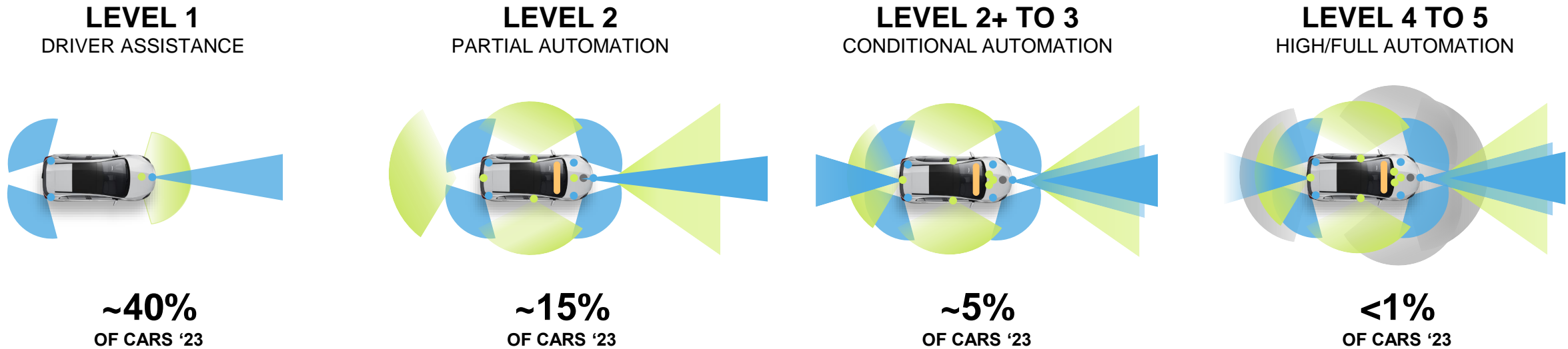
**LEVEL 4 TO 5**  
HIGH/FULL AUTOMATION

VEHICLE OWNERSHIP: TRENDING TOWARDS HIGHER AUTOMATION

MOBILITY AS A SERVICE

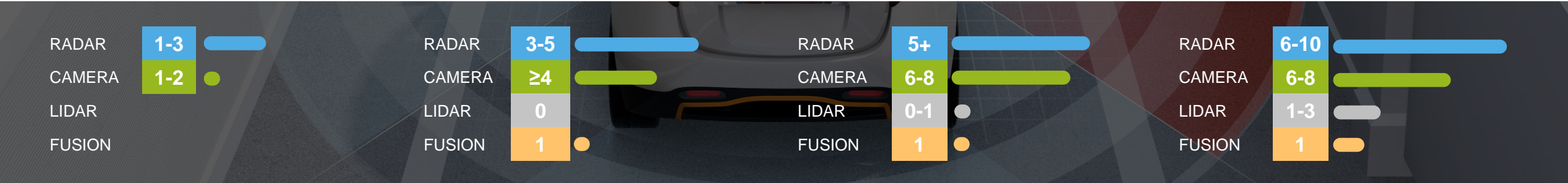


**~60% OF ALL NEW VEHICLES IN 2023 WILL BE PARTLY AUTOMATED AND CONTAIN RADAR**



VEHICLE OWNERSHIP: TRENDING TOWARDS HIGHER AUTOMATION

MOBILITY AS A SERVICE

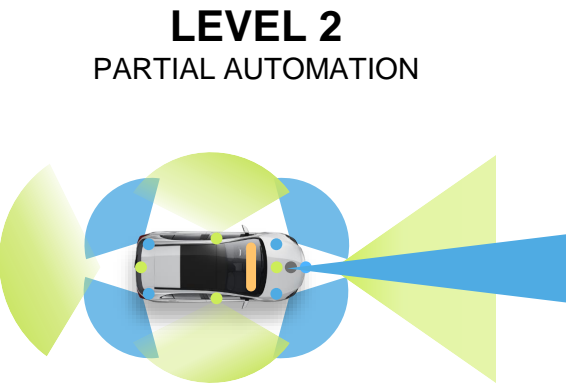




99% OF THE ADAS SEMICONDUCTOR VALUE IN 2023 IN LEVELS 1-3



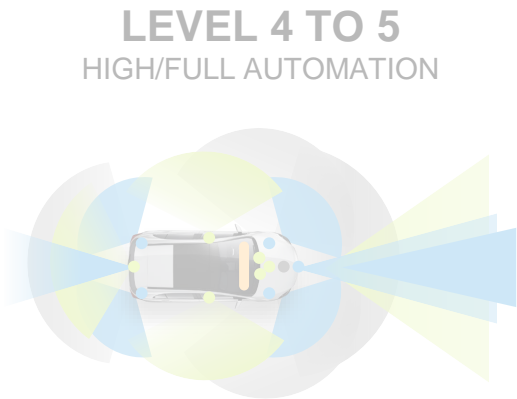
**~40%**  
OF CARS '23



**~15%**  
OF CARS '23



**~5%**  
OF CARS '23

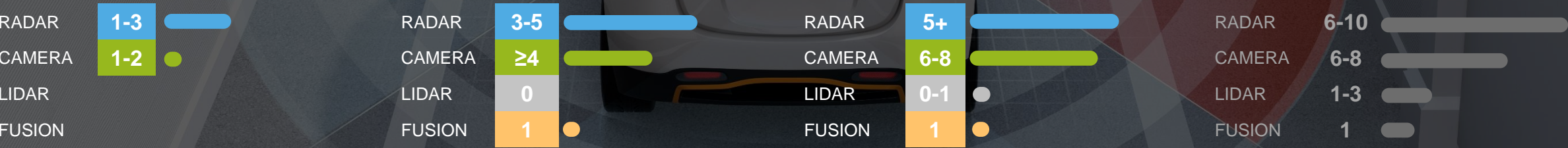


**<1%**  
OF CARS '23

VEHICLE OWNERSHIP: TRENDING TOWARDS HIGHER AUTOMATION

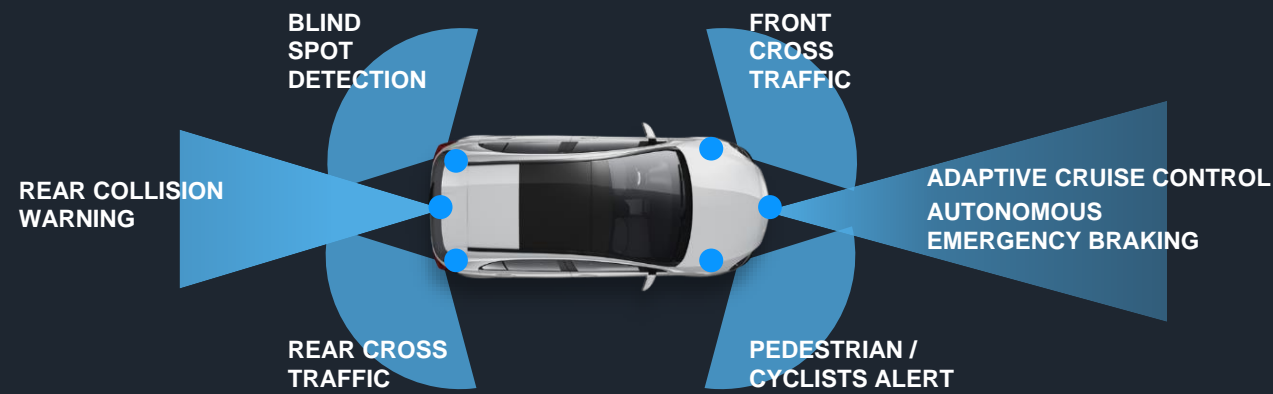
MOBILITY AS A SERVICE

99% of VALUE in 2023 for ADAS semiconductors represented by Level 1-3





# RADAR ADOPTION ACCELERATED BY MANDATES & NCAP; L2+ EVOLVING AS L3 “LIGHT”



## L2+ AUTONOMOUS DRIVING CLOSE TO L3

Semi content and features of L3 with driver responsibility  
Significant safety & comfort while avoiding L3 liability concerns  
From basic driver support to highway & urban pilot

## SAFETY RATINGS

Driving Radar Adoption globally

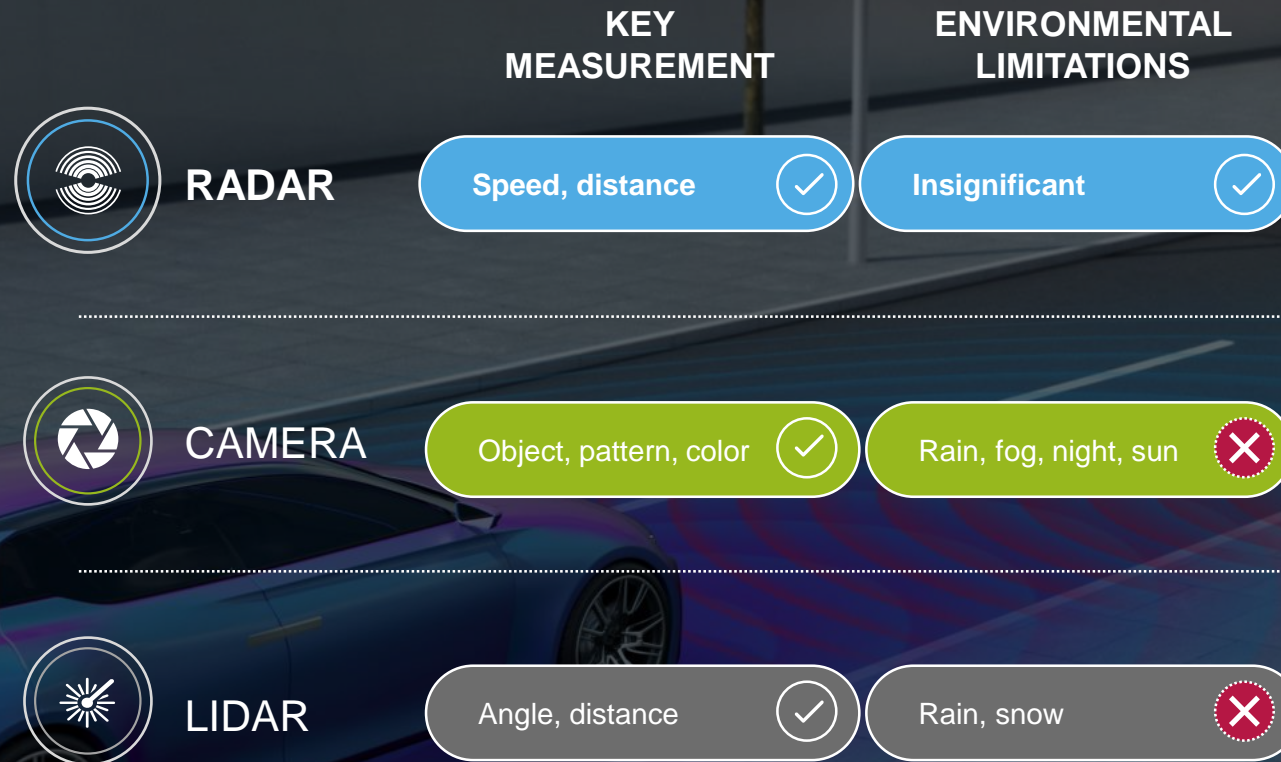


## DRIVER ASSISTANCE REQUIRES MULTIPLE COMPLEMENTARY SENSORS





# RADAR IS FUNDAMENTAL AND COMPLEMENTARY TO CAMERA FOR SAFETY





# ADAS SYSTEMS: RADAR IS MOST FUNDAMENTAL AND ROBUST SENSOR



**RADAR**

KEY  
MEASUREMENT

Speed, distance



ENVIRONMENTAL  
LIMITATIONS

Insignificant



**CAMERA**

Object, pattern, color



Rain, fog, night, sun



**LIDAR**

Angle, distance



Rain, snow



# RADAR IS EVOLVING TOWARDS PRECISE MAPPING OF ENVIRONMENT

## RADAR TECHNOLOGY



### RADAR

#### KEY MEASUREMENT

Speed, distance



#### ENVIRONMENTAL LIMITATIONS

Insignificant



### CAMERA

Object, pattern, color



Rain, fog, night, sun



### LIDAR

Angle, distance



Rain, snow



BULKY MODULES

POWER HUNGRY

LOW RANGE  
RESOLUTION

LOW ANGULAR  
RESOLUTION

24 GHz

77 GHz

SiGe

RFCMOS

Low  
channel count

High channel  
MIMO

<1GFlops

>350GFlops  
+ Accelerator

**SMALL MODULES**  
3x smaller antennas

**POWER EFFICIENT**  
30% lower power

**HIGH RESOLUTION**  
~20x range resolution

**LIDAR LIKE  
OBJECT SEPARATION**  
<1° angular resolution

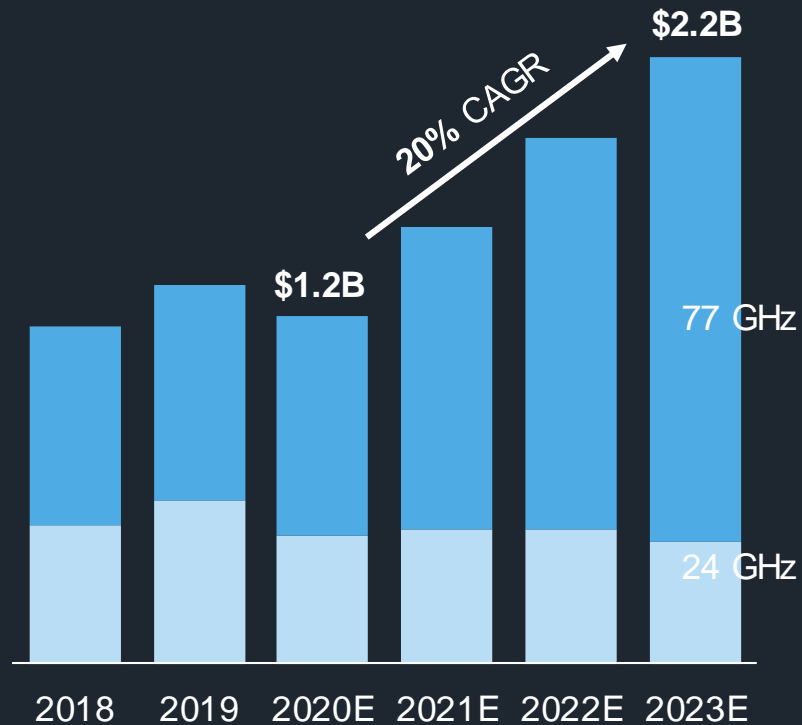
DETECTING  
A CAR

PRECISE MAP  
OF ENVIRONMENT



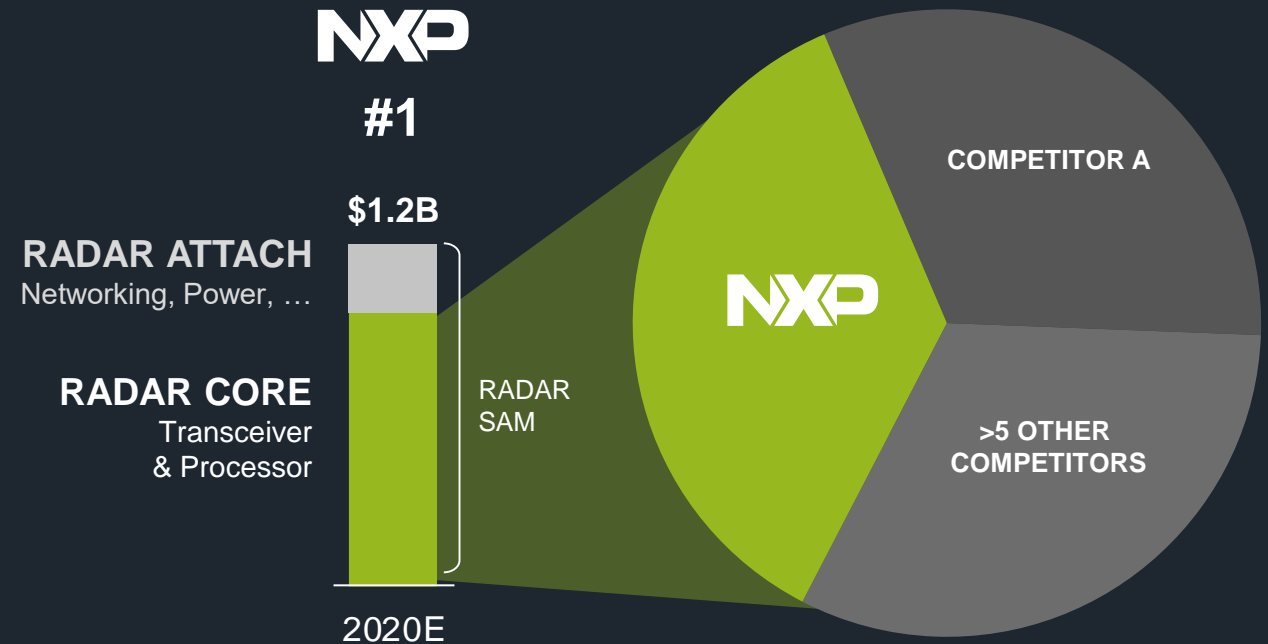
# NXP IS THE #1 SEMICONDUCTOR SUPPLIER IN THE HIGH GROWTH RADAR MARKET

## AUTOMOTIVE RADAR SAM



- The transition to 77GHz is the key to growth

## RADAR CORE ~10% OF NXP AUTOMOTIVE SALES



- NXP is #1 in 77 GHz Radar Core value
- NXP leading in RFCMOS & processing



# TRIPLE ACCELERATION OF THE RADAR MARKET

More Cars  
With Radar  
Largely 77 GHz



## FRONT RADAR



Autonomous emergency brake & adaptive cruise control

More Radar  
Nodes per Car



360° view - from 24 GHz to 77 GHz

## CORNER RADAR



Blind spot, front & rear cross traffic / people detection

More Semiconductor  
Content & \$ per Node  
High resolution imaging radar

## IMAGING RADAR



Precise environment map and localization

# TRIPLE ACCELERATION OF THE RADAR MARKET: JUST GETTING STARTED

More Cars  
With Radar  
Largely 77 GHz



More Radar  
Nodes per Car  
360° view - from 24 GHz to 77 GHz



More Semiconductor  
Content & \$ per Node  
High resolution imaging radar

## IMAGING RADAR



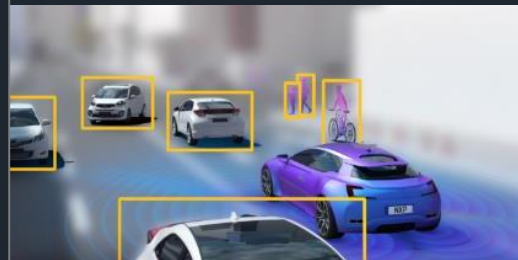
Precise environment map and localization

## FRONT RADAR



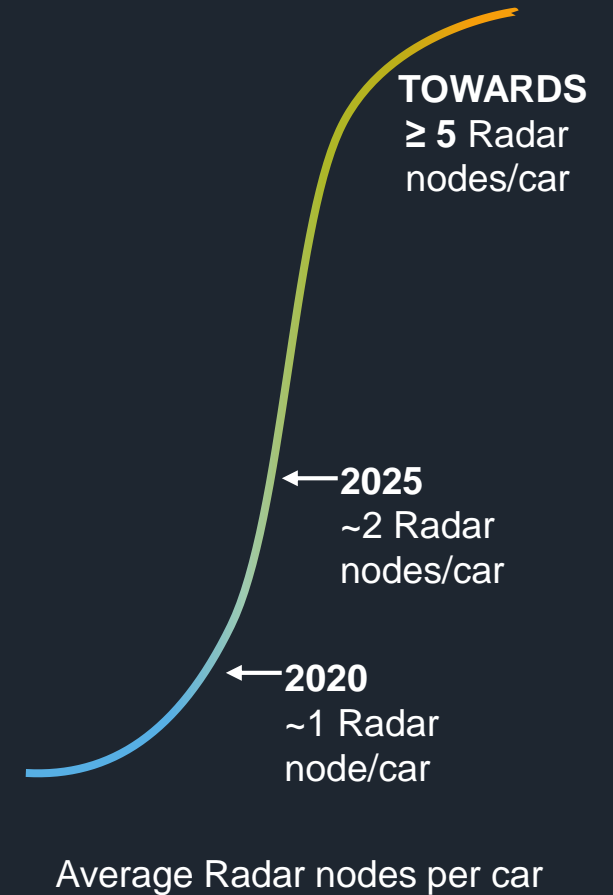
Autonomous emergency brake & adaptive cruise control

## CORNER RADAR



Blind spot, front & rear cross traffic / people detection

Average Radar nodes per cars produced globally



# RADAR TECHNOLOGY EVOLUTION TOWARDS ZERO ACCIDENTS





# RADAR EVOLUTION: PROCESSOR & TRANSCIEVER TECHNOLOGY ENHANCES SAFETY

SEEING  
OTHER CARS



24 GHz  
SiGe  
LOW  
RESOLUTION

77 GHz  
SiGe  
HIGHER  
RESOLUTION



PEDESTRIANS,  
BICYCLES

77 GHz + ADVANCED  
RFCMOS PROCESSING

HIGHER INTEGRATION  
RESOLUTION BOOST

# RADAR EVOLUTION: MORE MARKET SEGMENTS EVOLVING – 360° & HIGHER PERFORMANCE

SEEING  
OTHER CARS



24 GHz  
SiGe

LOW  
RESOLUTION

PEDESTRIANS,  
BICYCLES



77 GHz  
SiGe

HIGHER  
RESOLUTION

77 GHz  
**RFCMOS**  
+  
ADVANCED  
PROCESSING

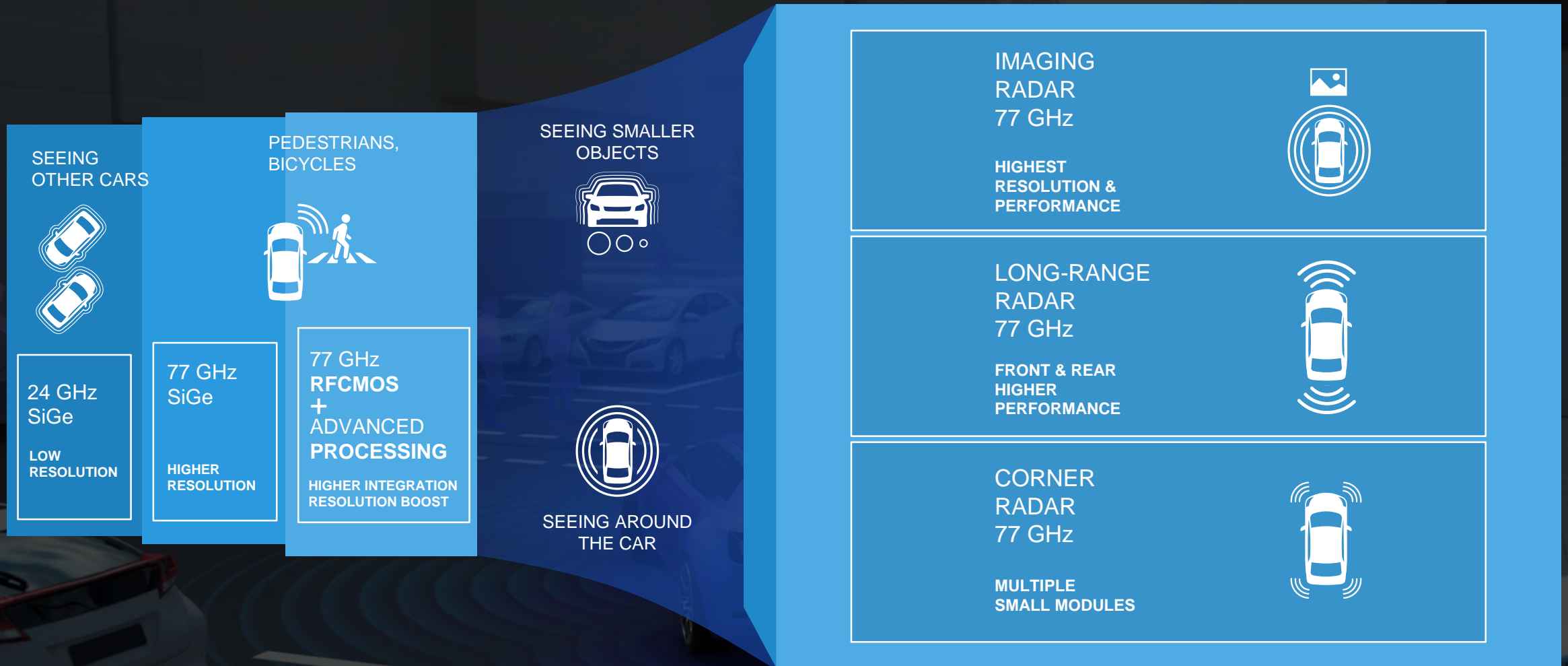
HIGHER INTEGRATION  
RESOLUTION BOOST

SEEING SMALLER  
OBJECTS



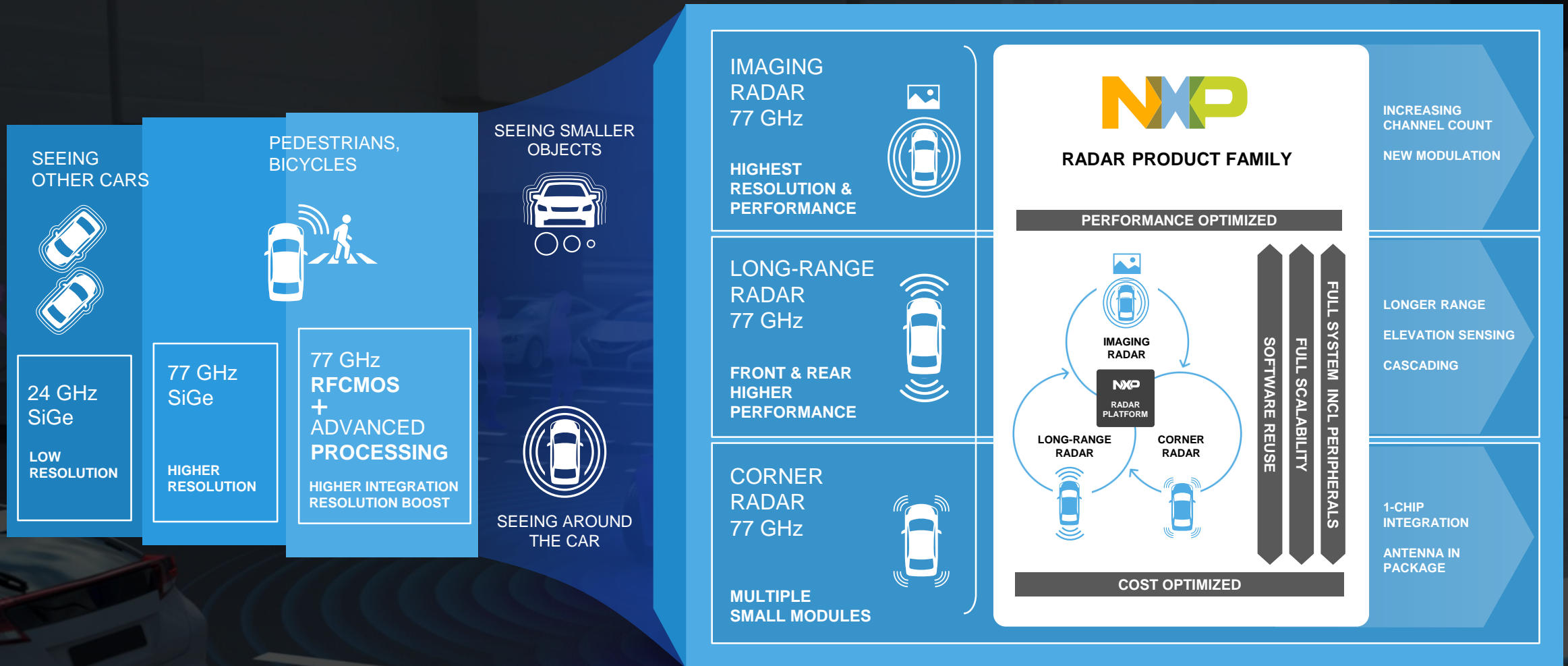
SEEING AROUND  
THE CAR

# RADAR EVOLUTION: SEGMENTATION FROM TINY CORNER RADAR UP TO IMAGING RADAR





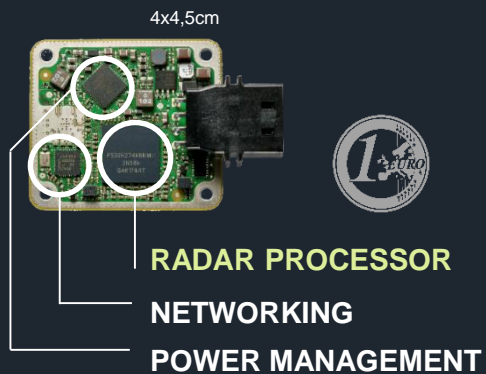
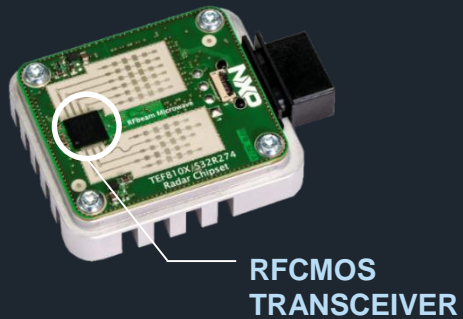
# NXP COVERING FULL RANGE AND COMPLETE SYSTEM WITH MAXIMUM SCALABILITY



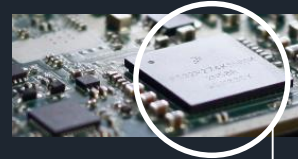
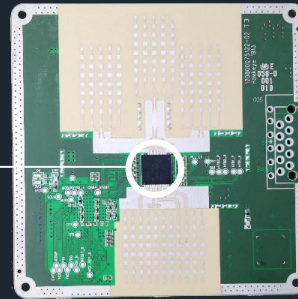
# NXP RADAR SYSTEM PORTFOLIO SCALING ACROSS ENTIRE MARKET OPPORTUNITY

## CORNER RADAR

FULL SYSTEM INCL PERIPHERALS

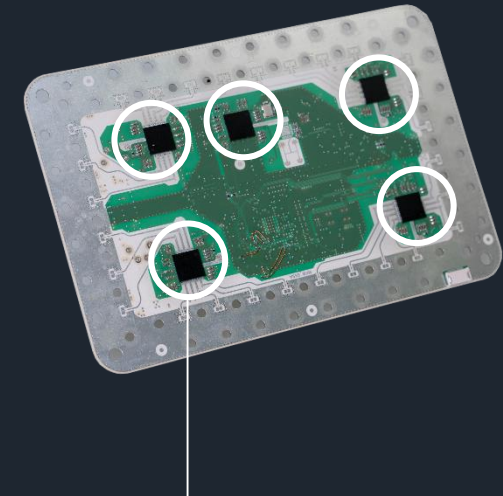


## LONG-RANGE RADAR



1-2 x RFCMOS TRANSCEIVERS  
+ ADVANCED RADAR PROCESSOR  
+ POWER MANAGEMENT AND NETWORKING

## IMAGING RADAR



5 x RFCMOS TRANSCEIVER  
+ HIGH PERFORMANCE IMAGING RADAR PROCESSOR  
+ POWER MANAGEMENT AND NETWORKING



FULL SCALABILITY - SAME TRANSCEIVER IC FAMILY

SOFTWARE REUSE - SAME PROCESSOR ARCHITECTURE

# NXP IS THE TRUSTED ADVISER AND INNOVATION PARTNER WITH OEMS AND TIER-1S

## INNOVATION TRIANGLE



### OEMs – NXP as trusted advisor

Close cooperation and joint innovation

Co-defining roadmaps and future architectures

### TIER-1s – NXP as partner supplier

Accelerating time to market with lead customers

Deep cooperation and support on application level

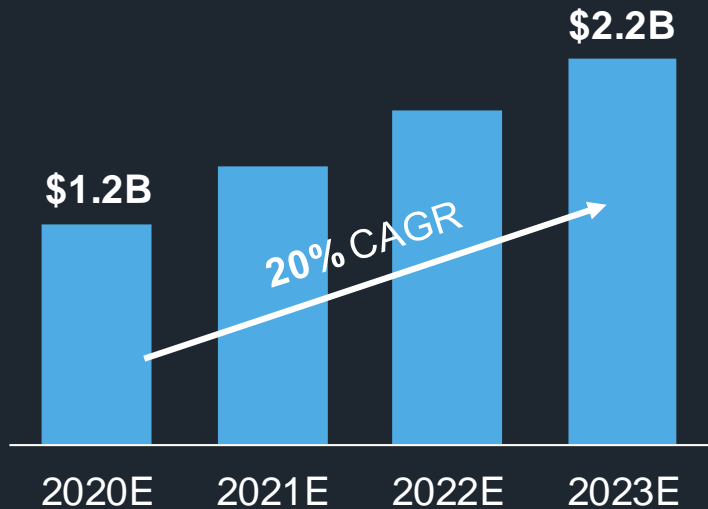
## DESIGNED IN AT 15 OF TOP 15 OEMS





# 85% OF FORWARD GROWTH UNDERPINNED WITH CONFIRMED DESIGN WINS

## STRONG MARKET GROWTH



- ✓ MORE CARS WITH RADAR
- ✓ MORE RADAR NODES PER CAR
- ✓ MORE SEMI CONTENT & \$ PER NODE

+

## OUTGROWING THE MARKET

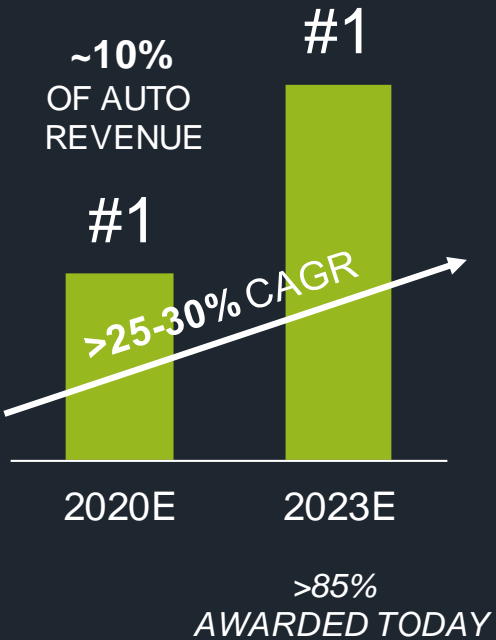
NXP GROWTH  
ESTIMATED  
2020-2023



- ✓ INNOVATION TRIANGLE  
OEM – NXP – TIER-1

=

## TRUE LEADER



- ✓ DESIGNED IN AT 15 OF TOP 15 CAR MAKERS



SECURE CONNECTIONS  
FOR A SMARTER WORLD