

Shift Left Verification of Automotive RADAR

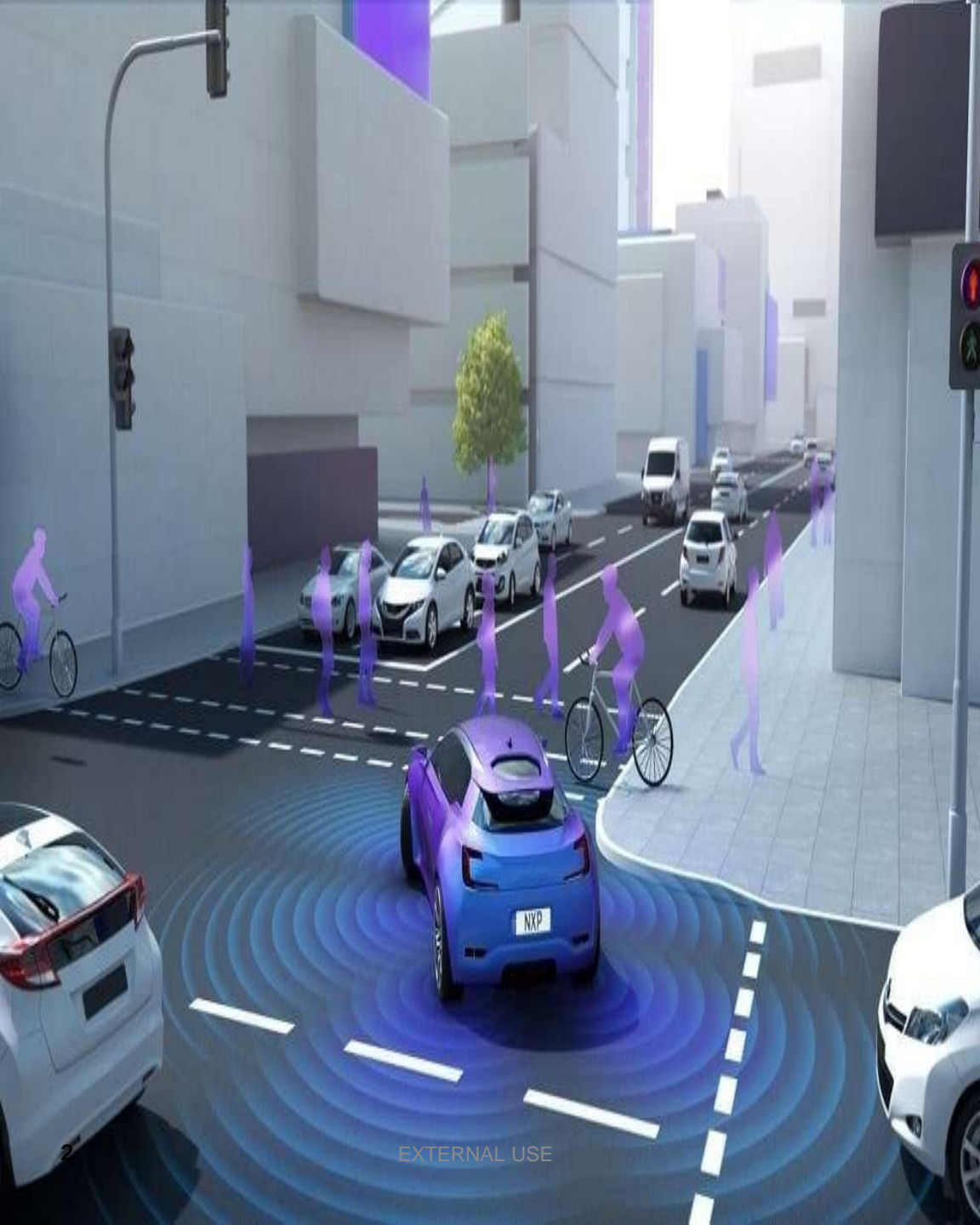
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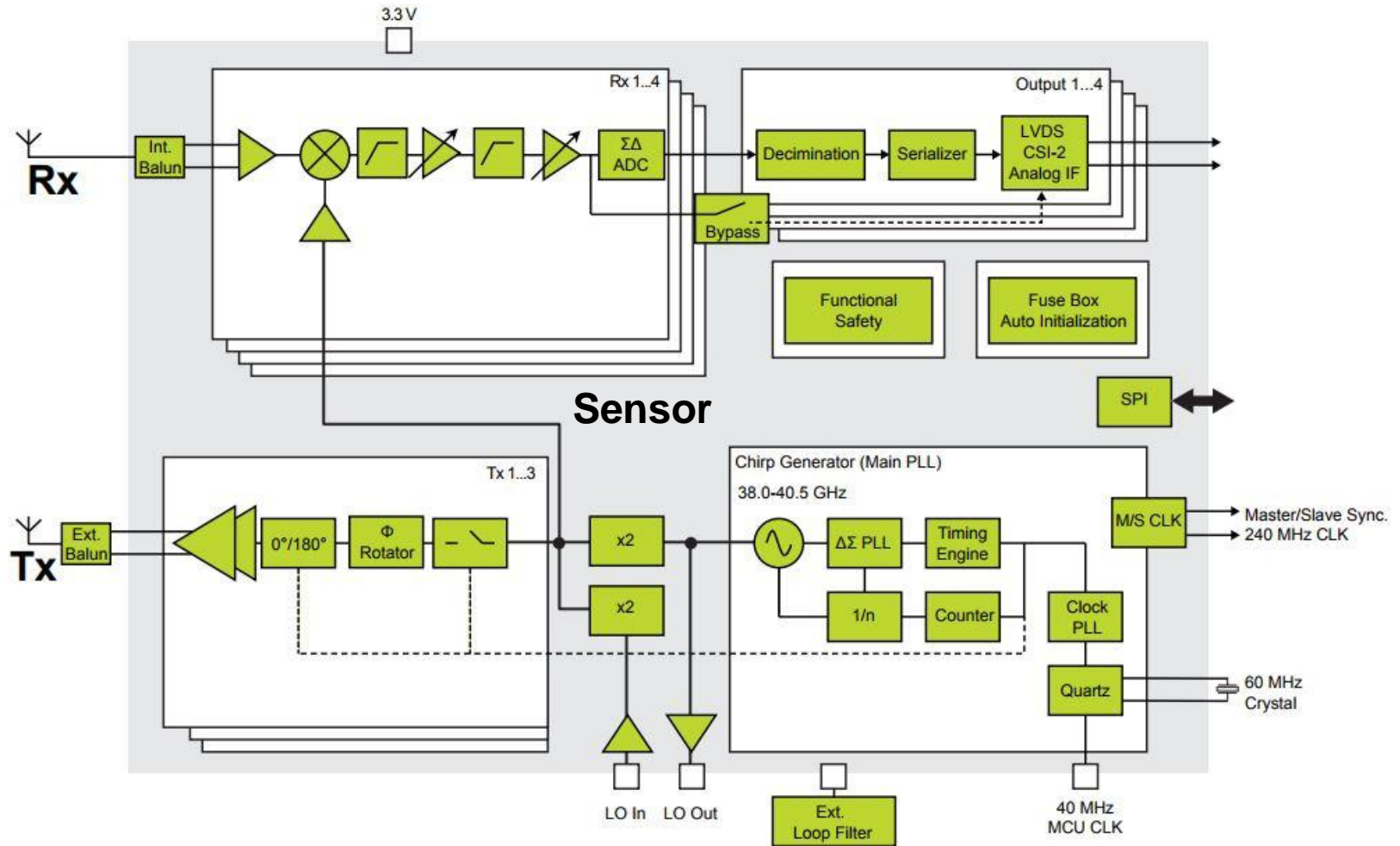
SECURE CONNECTIONS
FOR A SMARTER WORLD

Agenda

- Radar Architecture
- Shift-Left Approach
- V&V Challenges
- Proposed Methodology
- Unified On-Road model
- Case Study
- Tools used
- Benefits
- Future work

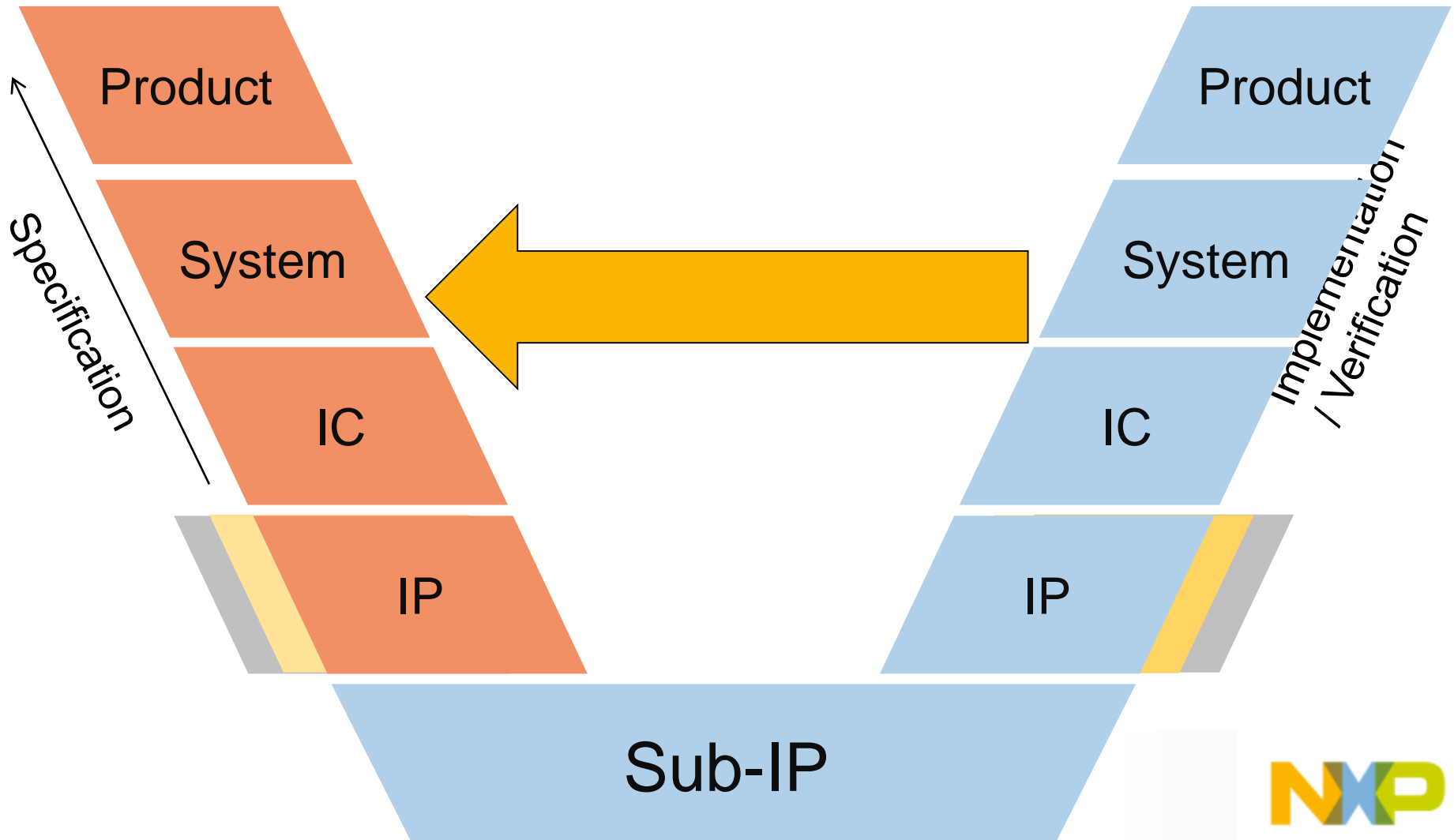


Automotive RADAR Architecture



Shift-Left Approach

Specification Validation prior to Implementation Verification



V&V Challenges



RF, Analog, and Digital IP developed and verified in isolation

System, IC and IP Verification workflows not integrated

Missing On-Road view in IP/IC/System V&V workflow

Need for realistic reflections for verifying Signal processing Algorithms

Certain road scenarios are dangerous to be tested during field trails

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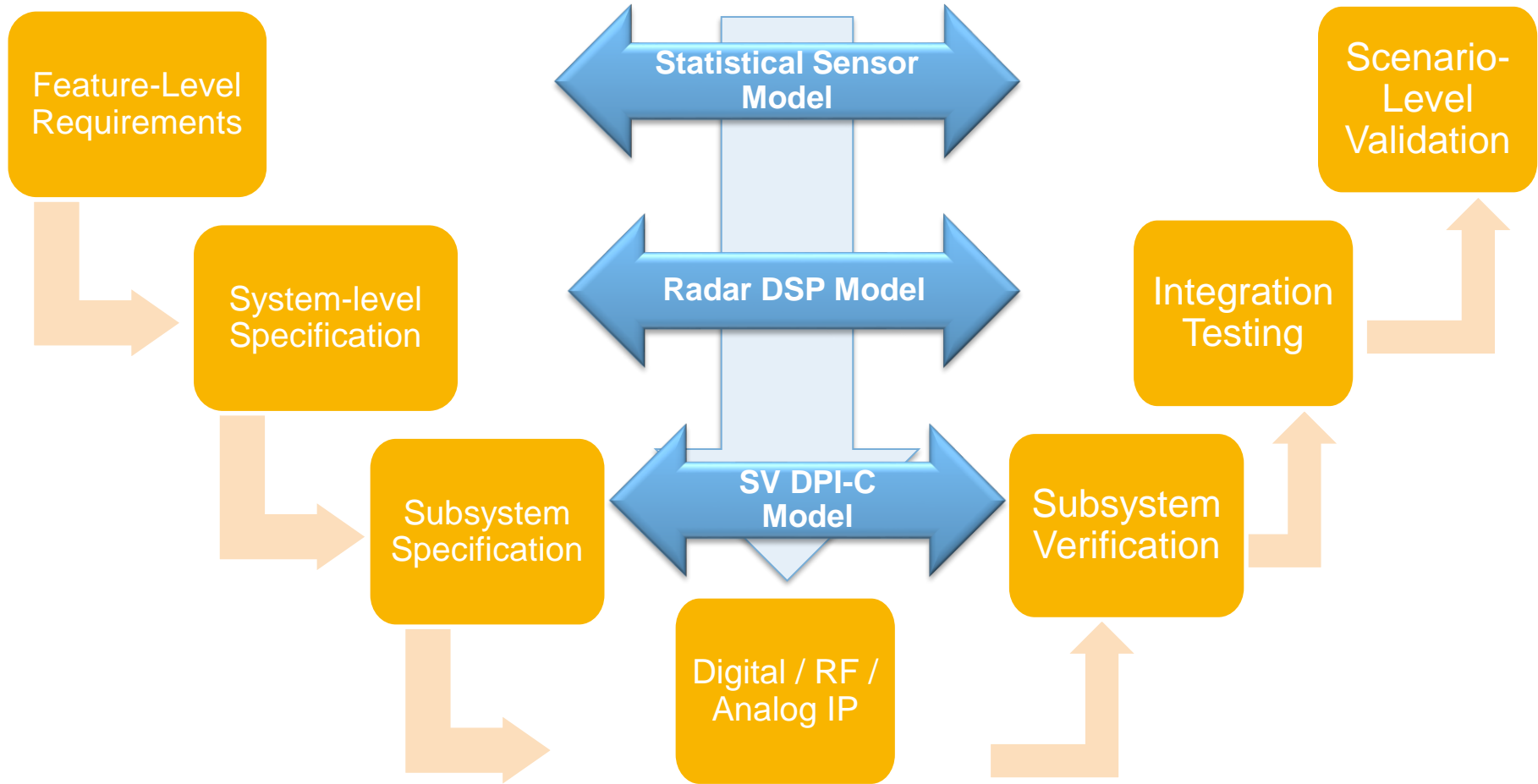
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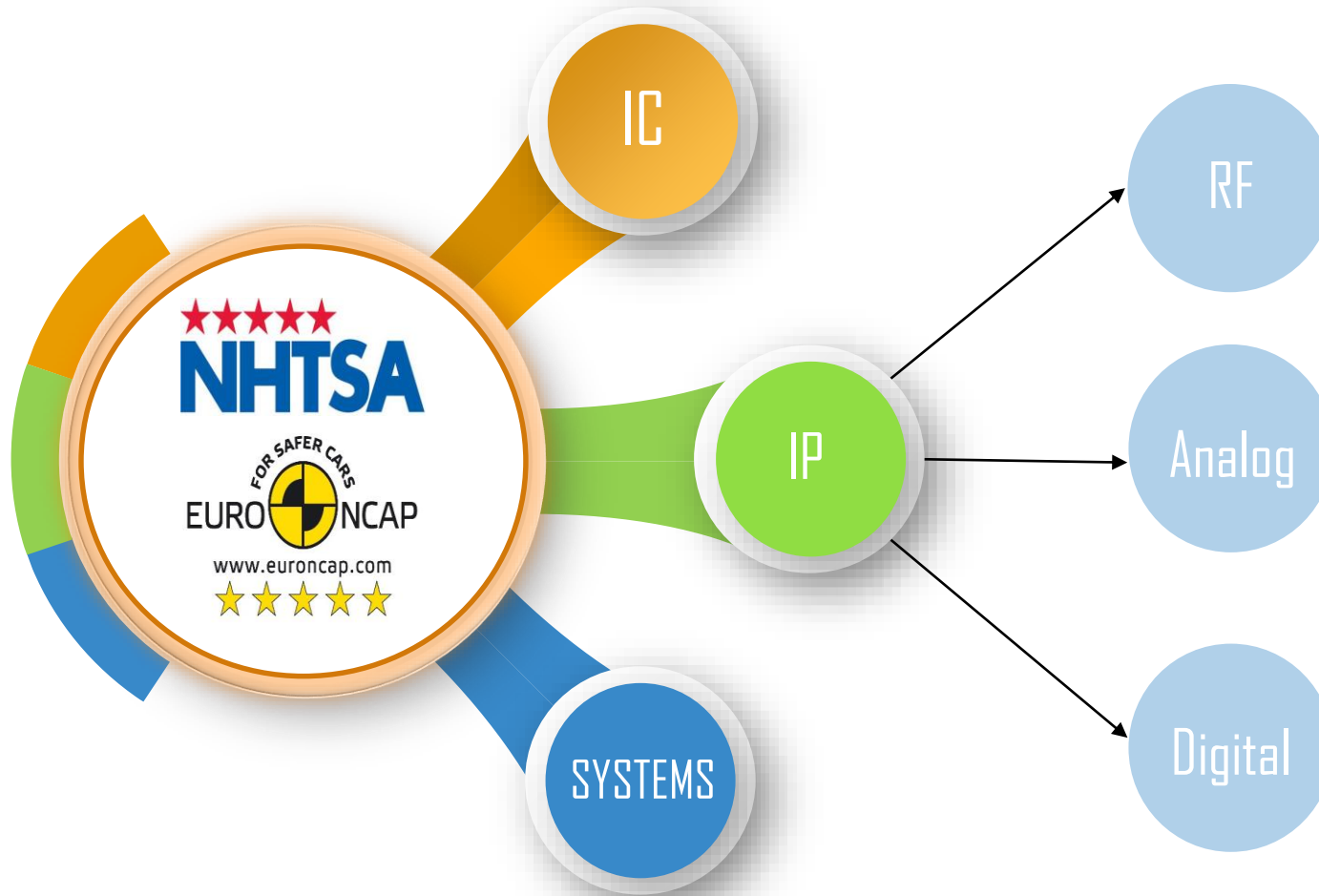
Certain road scenarios are dangerous to be tested during field trails

Objective: On-Road Env. in V&V workflows

Proposed Methodology



Unified Road Model



Case Study → Road Modelling

Road & Actor modelling

Driving Scenario Designer - drive.mat - Actors <@apc6222.in-blr01.nxp.com>

DESIGNER

FILE SCENARIO SENSORS SIMULATE VIEW EXPORT

New Open Save Add Road Add Actor Add Camera Add Radar Go to Start Step Back Run Step Forward Settings Repeat Default Layout Export

Roads Actors Sensors Scenario Canvas Sensor Canvas Ego Centric View Bird's Eye Plot

1: Car (ego car)

Name: Car Set As Ego Car

Class: Car

▼ Actor Properties

Length (m): 4.7 Width (m): 1.8 Height (m): 1.4

Front: 0.9 Rear: 1

Roll: 0 Pitch: 0 Yaw: 0

▼ Radar Cross Section Import

Azimuth Angles (deg): [-180 180]

Elevation Angles (deg): [-90 90]

Pattern (dBsm)

	-180	180
-90	10	10
90	10	10

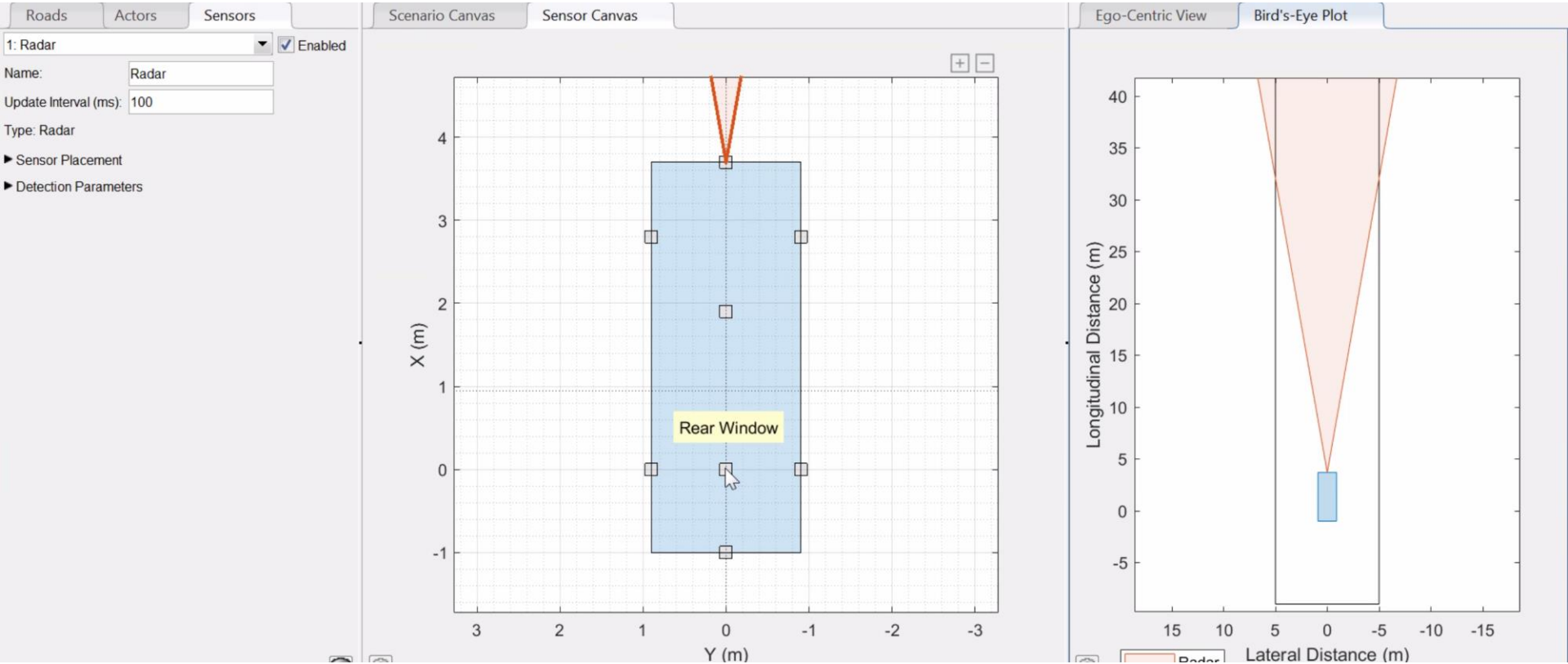
▼ Trajectory

Constant Speed (m/s): 22.2222

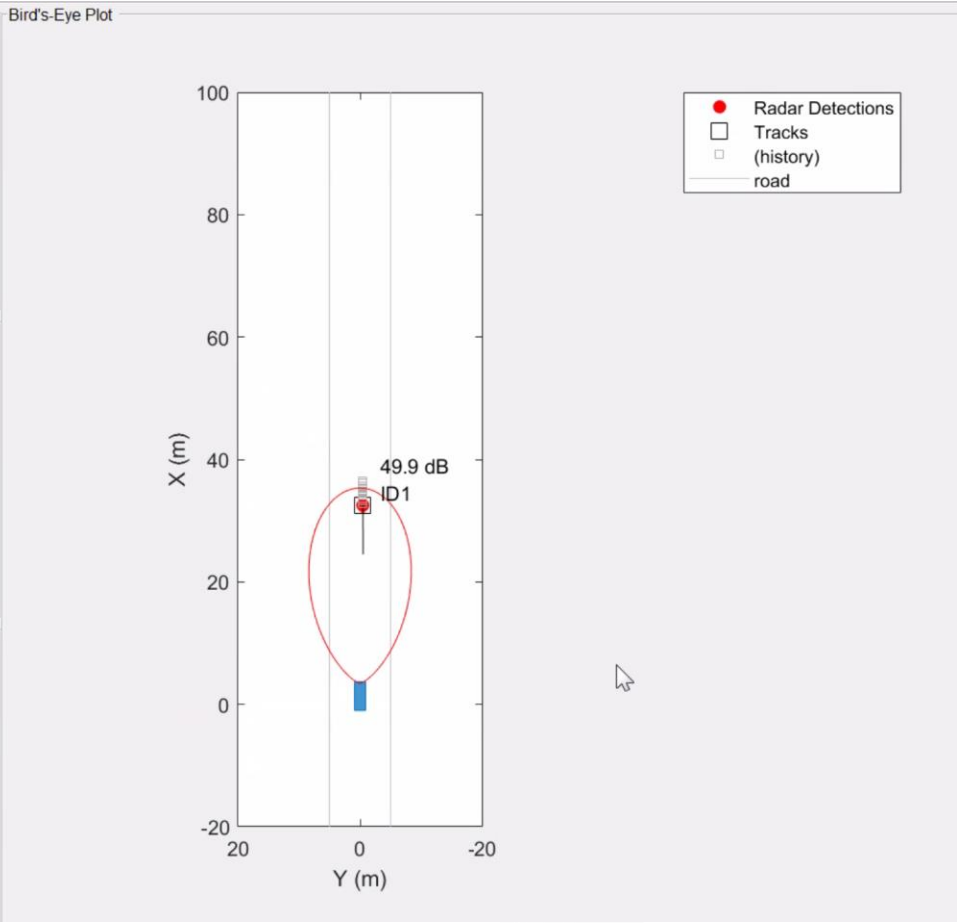
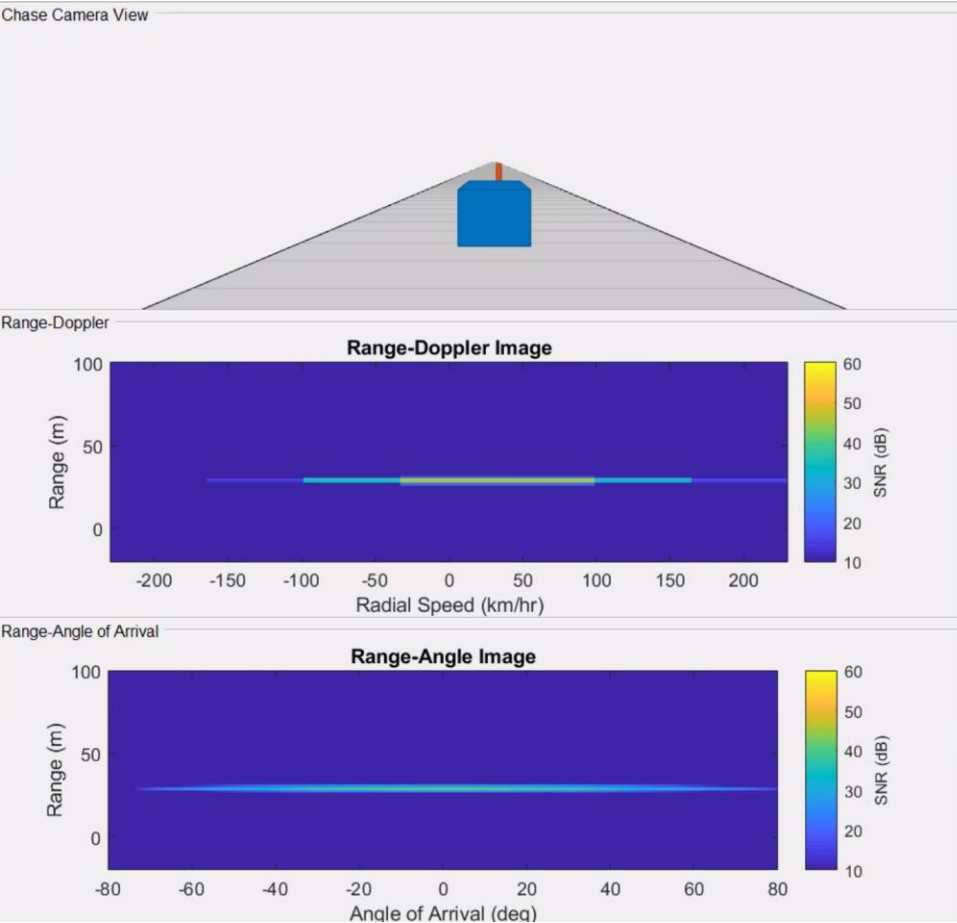
Waypoints

	x (m)	y (m)	z (m)
1	-41	52.5000	0
2	-10	52.5000	0
3	30	52.5000	0

Case Study → Sensor Modelling



Case Study → Emulating Field Trail



Case Study → Results

Dechirped data of Env..

Magnitude spectrum and Range Calculation

Range Vs Ground Truth

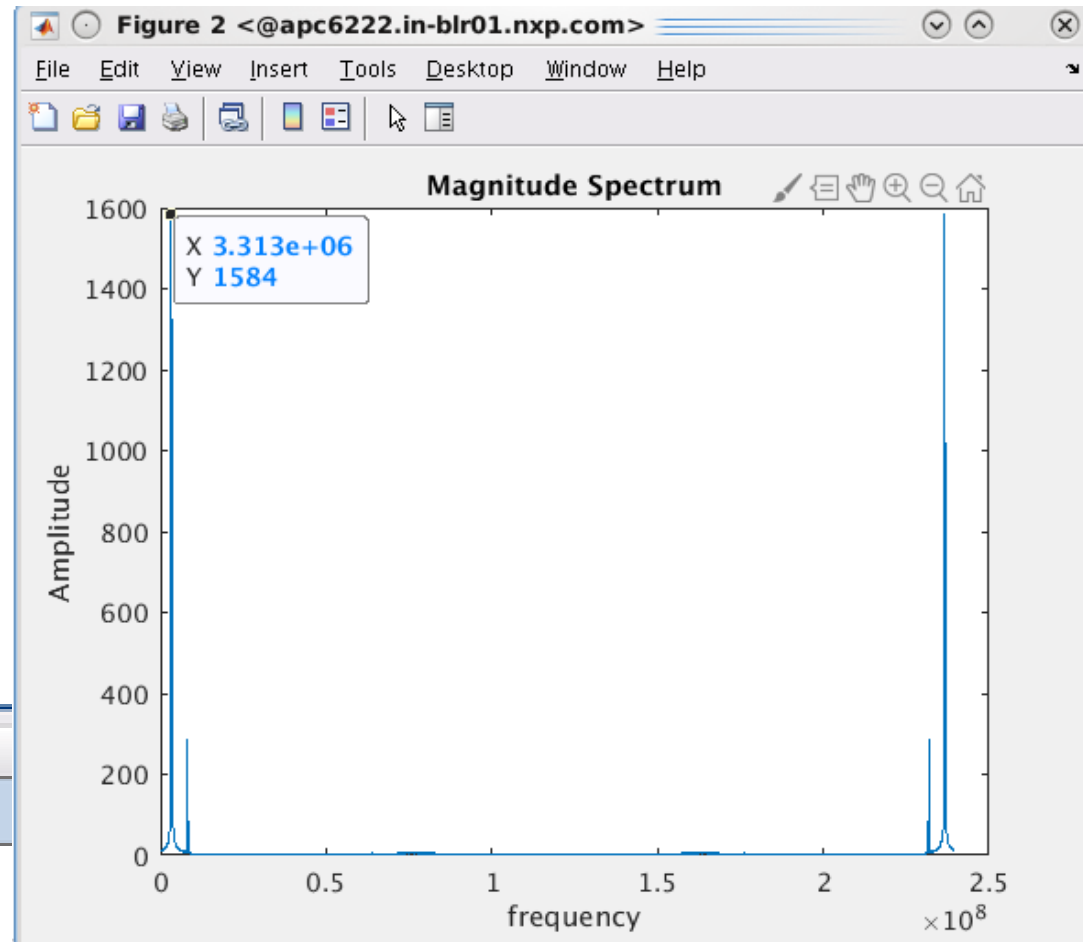
Command Window

New to MATLAB? See resources for [Getting Started](#).

```
c = 1000000000;  
tchirp=30e-06;  
bw=2.*10^9;  
R=(c.*fb.*tchirp)./(2.*bw);  
disp('range');  
disp(R);  
range  
7.4475
```

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EXTERNAL USE



Tools Used

MATLAB

Signal Processing Toolbox

Phased Array System Toolbox

Automated Driving Toolbox

Simulink

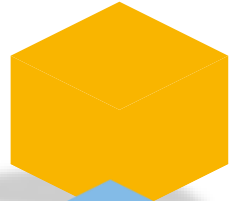
Sensor Fusion and Tracking Toolbox

DSP Toolbox

Benefits

- Easy to model realistic field environments and verify the design
- Early Design exposure to On-Road Env. → **Virtual Field Trial**
- Unified On-Road view across V&V abstractions
- Connect Design-In to IC V&V

Future Scope



Baseband integration into model



Modelling RF Impairments



Modelling Environmental effects



MATLAB-Hw Co-Simulation





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