

# Pre-silicon digital verification sign-off at Infineon ATV MC

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## Context - Process

### Product Verification Manager for Aurix3G family of microcontrollers

- Definition of verification processes
  - Executed by large number of people – need consistency
  - Aurix3G used in safety critical automotive applications including ADAS, drive-by-wire, airbag and powertrain
    - Sign-off must ensure compatibility with ISO26262 Standard
- In this context verification encompasses
  - Pre-silicon verification including digital, analogue, AMS, power-aware, timing, manufacturability, ...
  - Post-silicon verification including validation, characterisation, reliability, test and safety analysis
- Focus on pre-silicon digital IP functional verification
  - Executed by around 100 teams based in seven sites across two continents

It's all in the planning ...

The background features several thin, light green lines that intersect to form a series of triangles and quadrilaterals. A solid, medium-green shape occupies the bottom portion of the slide, sloping upwards from left to right. A small, solid green circle is positioned at the vertex where two lines meet, just above the green shape.

# Product Verification Plan (PVP)

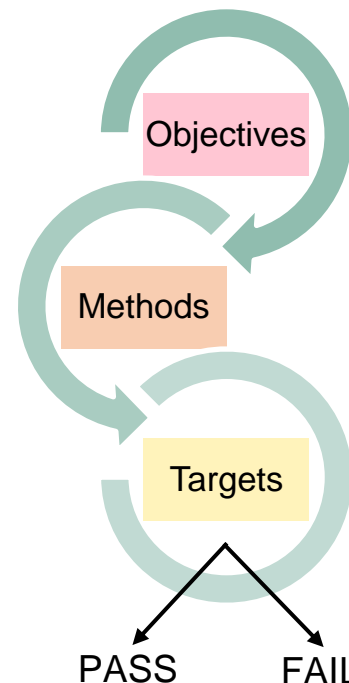
*Our goals can only be reached through the vehicle of a plan, in which we must fervently believe, and upon which we must vigorously act. There is no other route to success — Pablo Picasso*

Product Verification Plan (PVP) sets the Verification **Objectives**, describes the Verification **Methods** that can be used and stipulates the Method-dependent **Targets** that show that the Objectives have been achieved  
Ensures *consistency* of execution and sign-off

## Objectives vs. Targets

Objectives can be quite abstract and written without detailed knowledge of how they will be achieved

Targets are an expert interpretation of Objectives and must be determinable – unambiguous PASS or FAIL



## Objectives


Showing that **Requirements** and **Features** are satisfied by the implementation

- **Requirements** are *verifiable statements* written by concept engineers derived from (not necessarily verifiable) customer requirements
- **Features** are *verifiable statements* written by verification engineers
  - Features are derived according to a table of methods listed in the PVP inspired by similar tables in the ISO26262 standard
    - Deriving methods including ‘analysis of boundary values’, ‘knowledge or experience based error guessing’, ...
    - Input taken from other stakeholders

Showing that all RTL code has been exercised

Showing that the DUV has been extensively soak tested

Increasingly  
Fine Safety Nets



## Methods and Targets

### Example Verification Targets for simulation-based verification

- **Test cases** determined as PASS across variety of checkers (reference model, assertions, self-check)
- **Functional Coverage** determined as PASS if hit by passing test cases
- **Branch** in RTL code determined as PASS if taken by passing test cases
- **Soak testing** determined as PASS if targeted number of generated test cases all passed

### Example Verification Targets for formal verification

- **Properties** determined to PASS if they hold non-vacuously or if they have a bounded hold for a sufficient number of cycles
- **Statement** in RTL code determined to PASS if tool says it has been covered by property set
- **Exhaustive verification** is a PASS if property set is complete and all properties PASS

... and in the specifying ...

The slide features several decorative green elements: a thin line starting from the top right and extending towards the center; another thin line starting from the left edge and extending towards the center; a small green circle at the intersection of these two lines; a thin line extending from the bottom of the circle towards the bottom edge; and a large, solid green shape at the bottom of the slide that tapers towards the left.

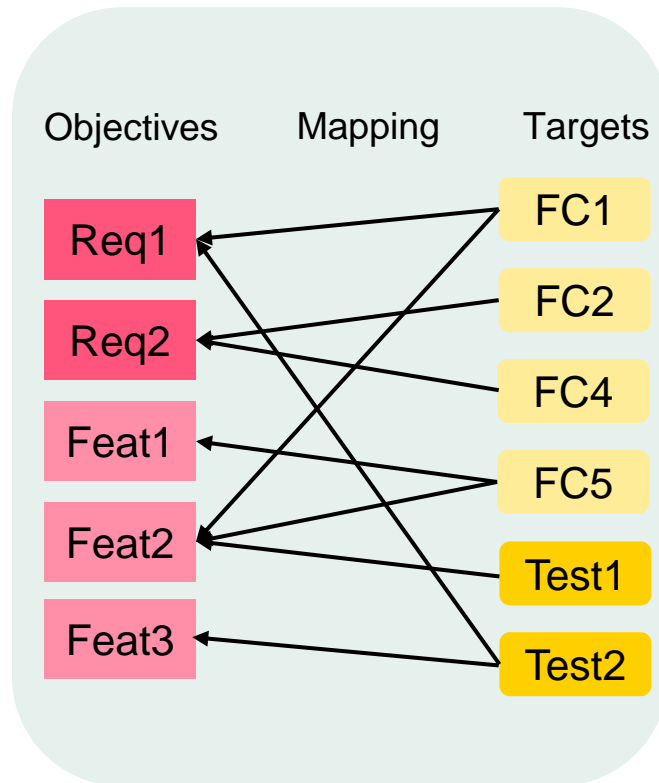
# Verification Specification

Plans are good but it's important to be specific  
 Each verification team writes a Verification Specification

- One PVP, 100+ Verification Specifications
- Requires Domain expertise

Each Verification Specification

- Includes specific Objectives for that team e.g. all relevant requirements and derived features
- Includes specific Targets for that team e.g. list of directed tests, functional coverage model
- Includes the mapping of Targets onto Objectives to ensure that all Objectives fully verified





.. and the rest is easy

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Execute

Report all Targets PASS

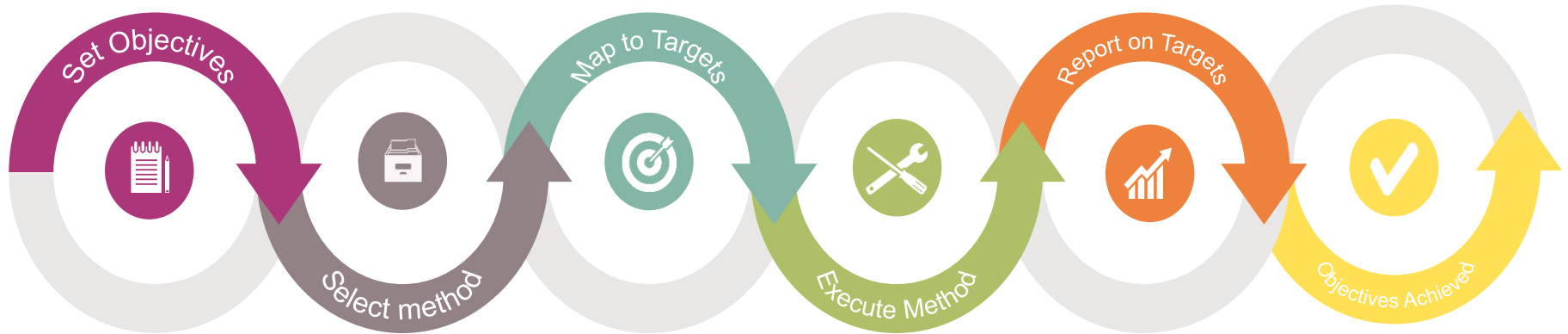
# Verification Environment Qualification

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Qualification of verification environment important part of sign-off

- Based on
  - Review
  - Ability to detect mutations inserted in design

# Summary



A futuristic car interior with a woman sitting in the driver's seat, reading a tablet. The car is illuminated with blue and white light, and the dashboard and steering wheel are visible. The background shows a blurred road with other cars and a large digital display on the windshield showing "Self-Driving" and "5100m". The overall scene is a conceptual representation of autonomous driving technology.

Questions?



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# Relating Objectives and Targets

- Verification of Requirements and Features satisfied by test cases, functional coverage and properties
- Exercising RTL code satisfied by branch or statement coverage (and ...)
- Soak testing satisfied by targeted soak testing

- Targets change with Method but Objectives are the same
- Targets are tool dependent e.g. can only show that RTL code has been exercised if there is a tool to do it
- Objectives can be defined by non-experts but sufficiency of Verification Targets in satisfying Objectives is based on experience

