Using Generic Software Components for Safety-Critical Embedded Systems

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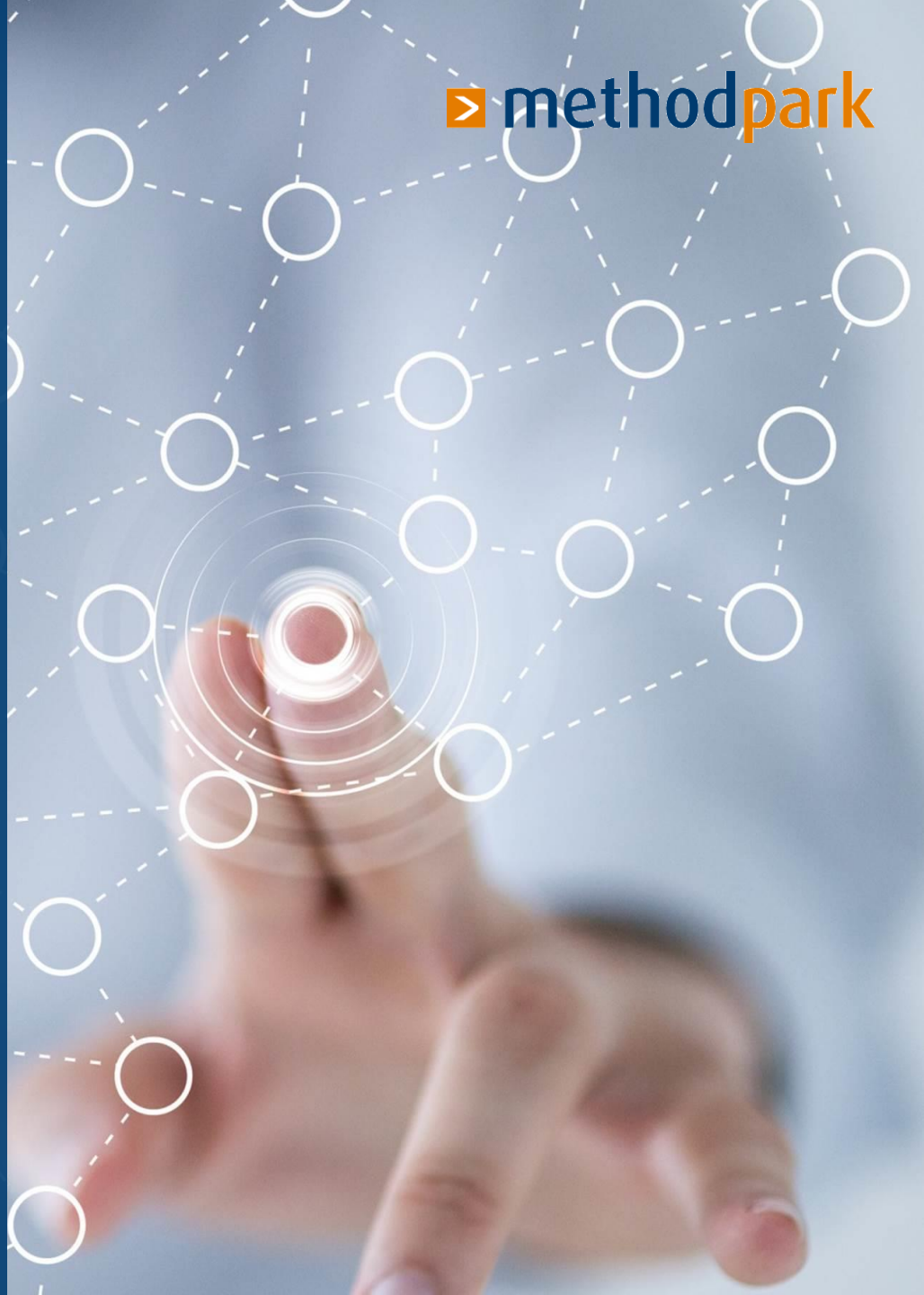
ERTS 2020



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aramis II

DEVELOPMENT PROCESSES I TOOLS I PLATFORMS
FOR SAFETY-CRITICIAL MULTICORE SYSTEMS

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Conflicting Priorities

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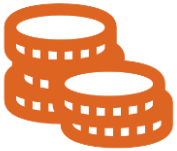
Safety

Cost



Efficiency

Reusability

Special vs. Platform Development

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Software Adaptation

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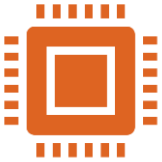
Software Platform

Adapting

Specific Product

Run Time Efficiency

Memory Efficiency



Specialized Hardware

Temporal Isolation

Spatial Isolation

Software Adaptation

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Software Platform

Adapting

Specific Product

System Architecture

Software Architecture

Software Implementation

Software Adaptation

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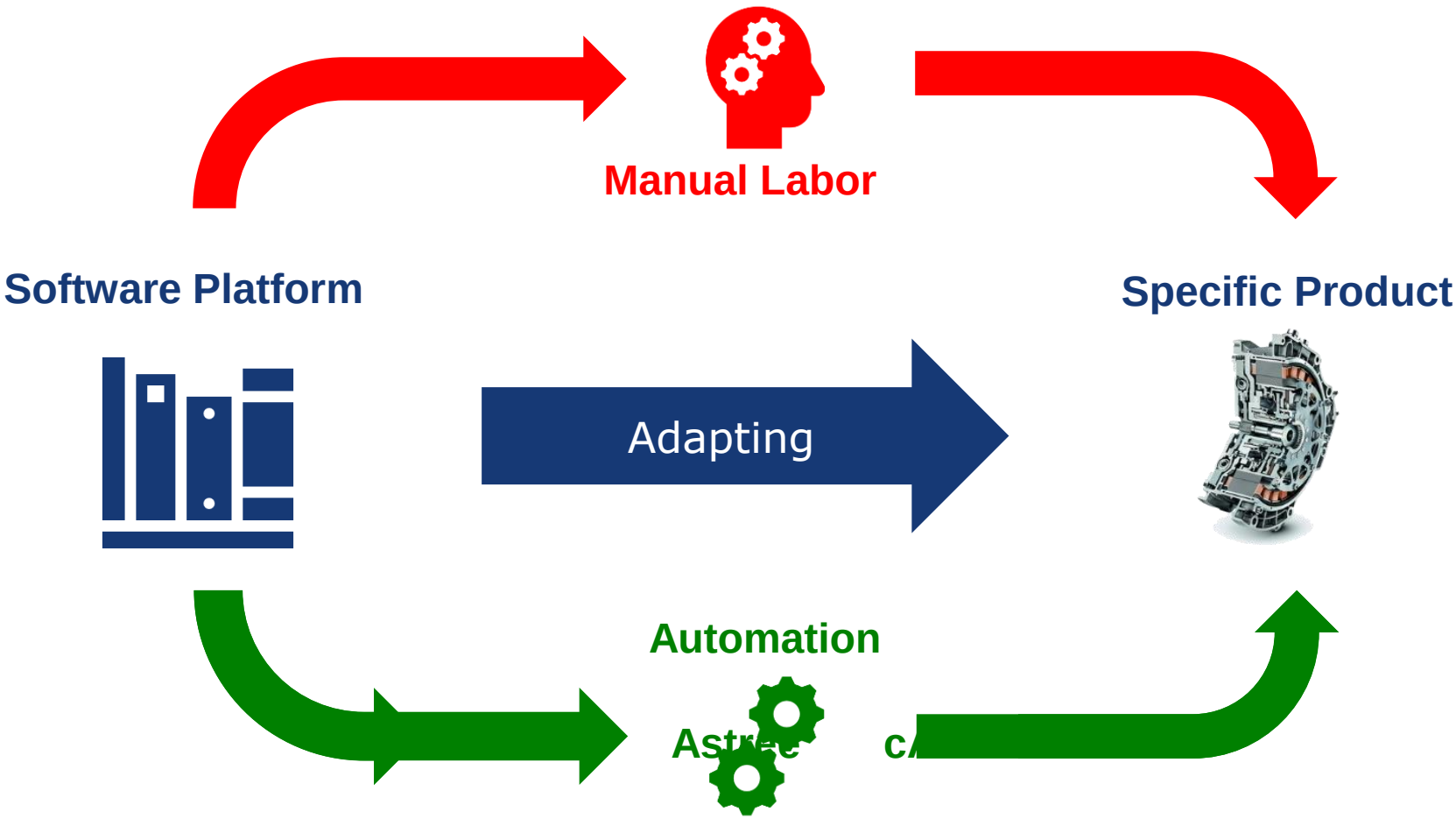

Adaptation Framework

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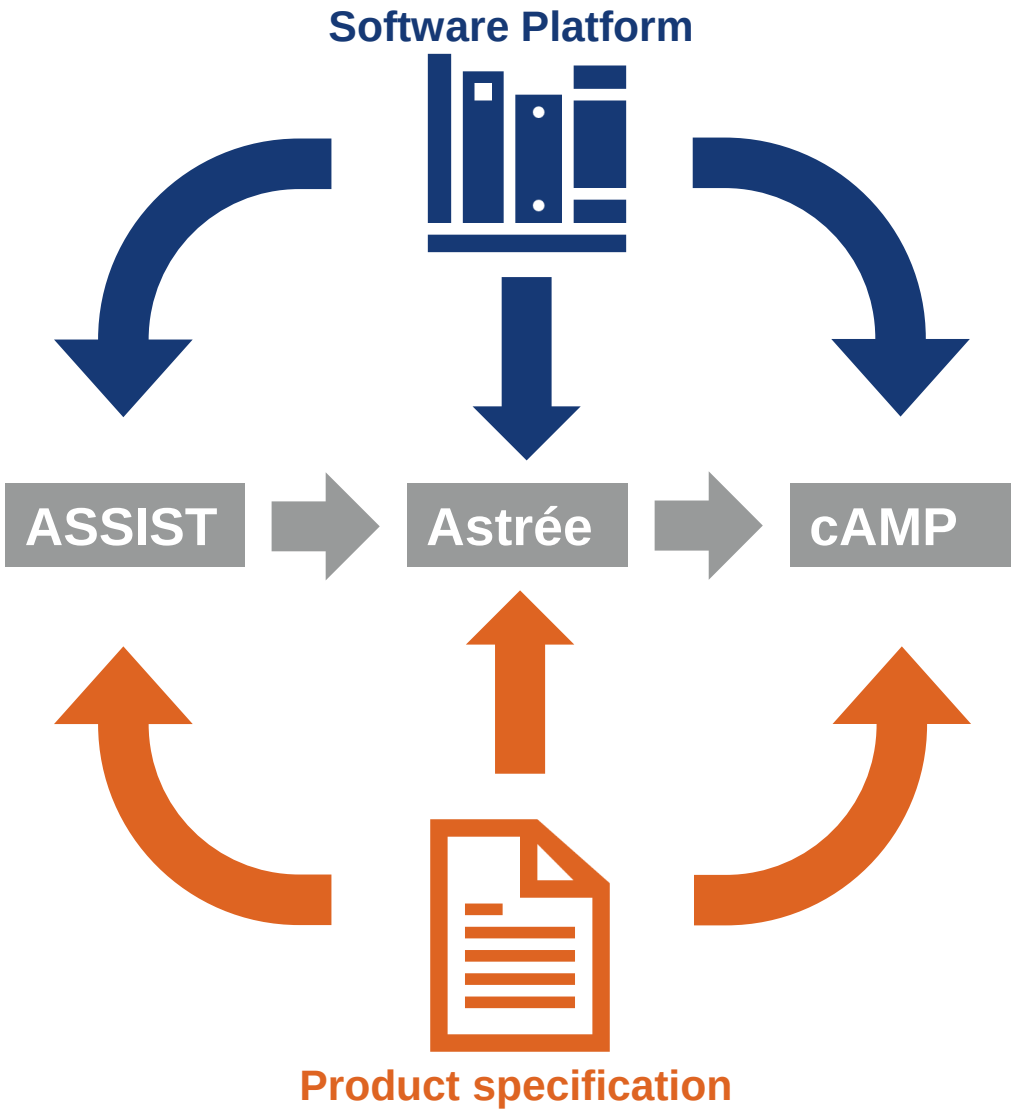

- Deployment
- Scheduling
- Type & Memory Safety
- Data Flow and Access
- Data Partitioning
- Memory Binding

Adaptation Technologies

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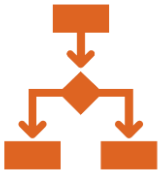
Software Platform

Adapting

Specific Product



Model-based Development

Static Analysis

Code Generation

Adaptation Base

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Software Platform

- **Basic Software Library**
- **Model-based Application Library**
- **Platform Target Hardware Description**

Product Specification

- **Safety Requirements**
- **Functional Architecture**
- **Non-functional Requirements**
- **Specific Hardware**

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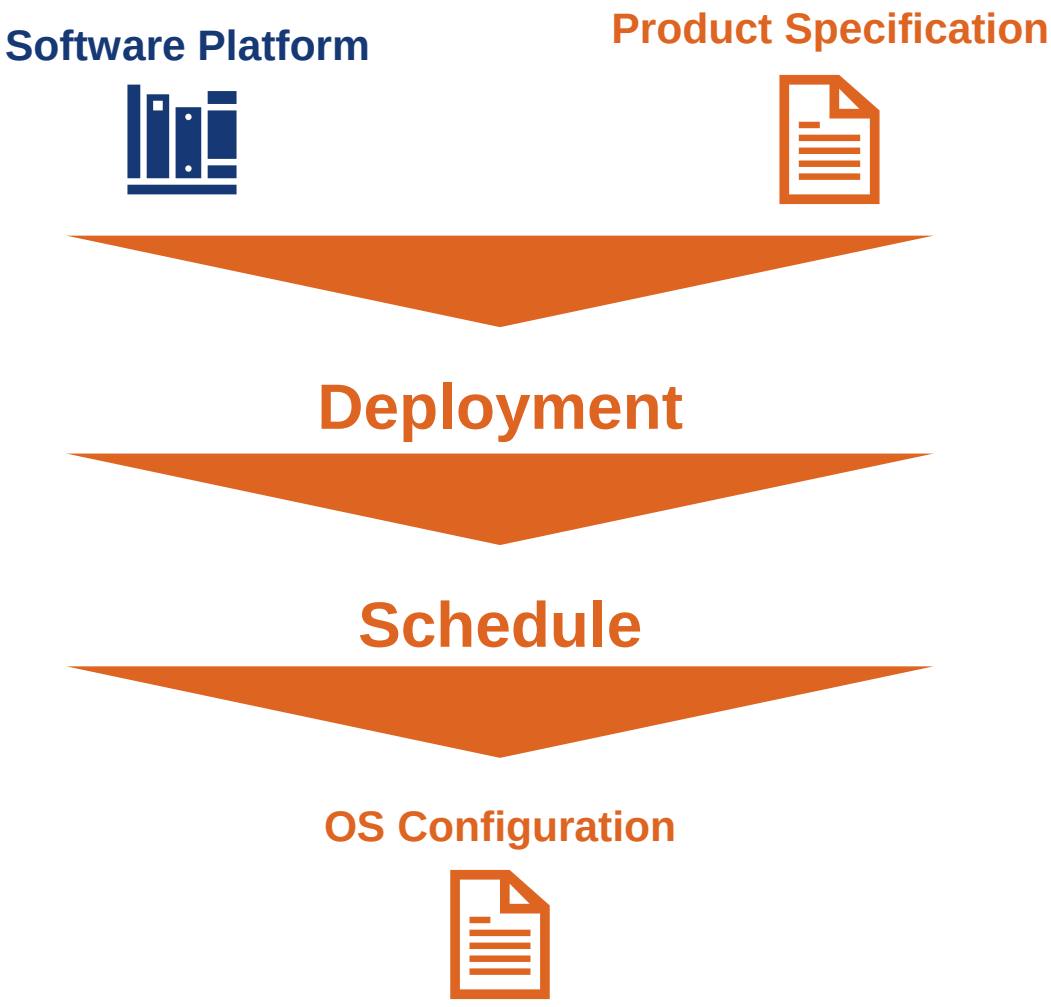
Software Platform
Product Specification
Deployment
Schedule
OS Configuration

ASSIST

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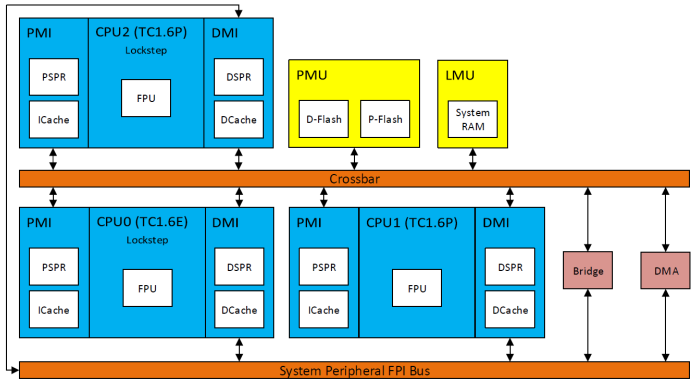
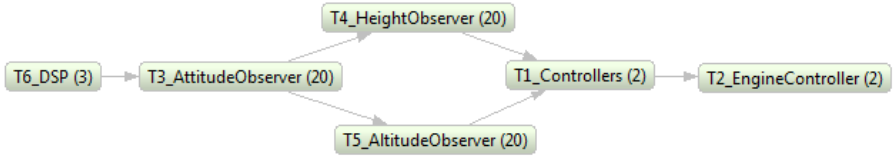
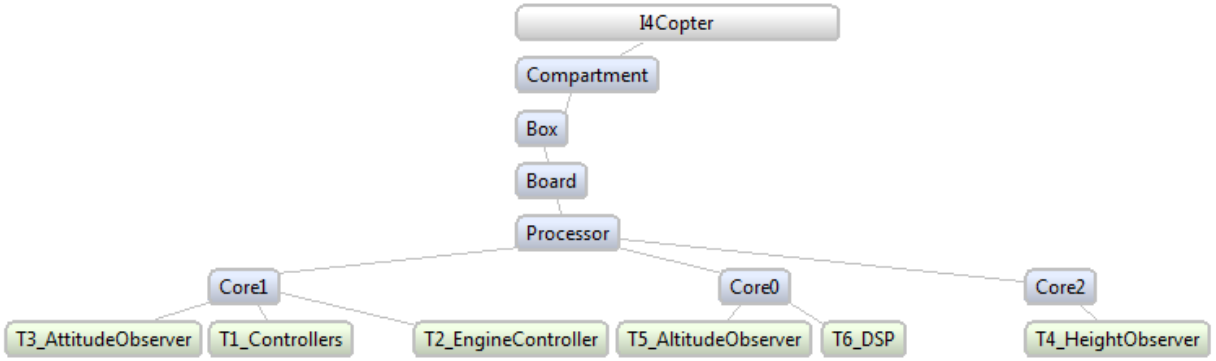


- Offers Floating Point Unit
- Offers Lock-Step Core
- Offers DMA
- Provides 4MB of Flash
- Provides 128kB of SRAM



- Requires MPU
- Requires FPU
- Takes 12kB of Flash
- Takes 960B of SRAM



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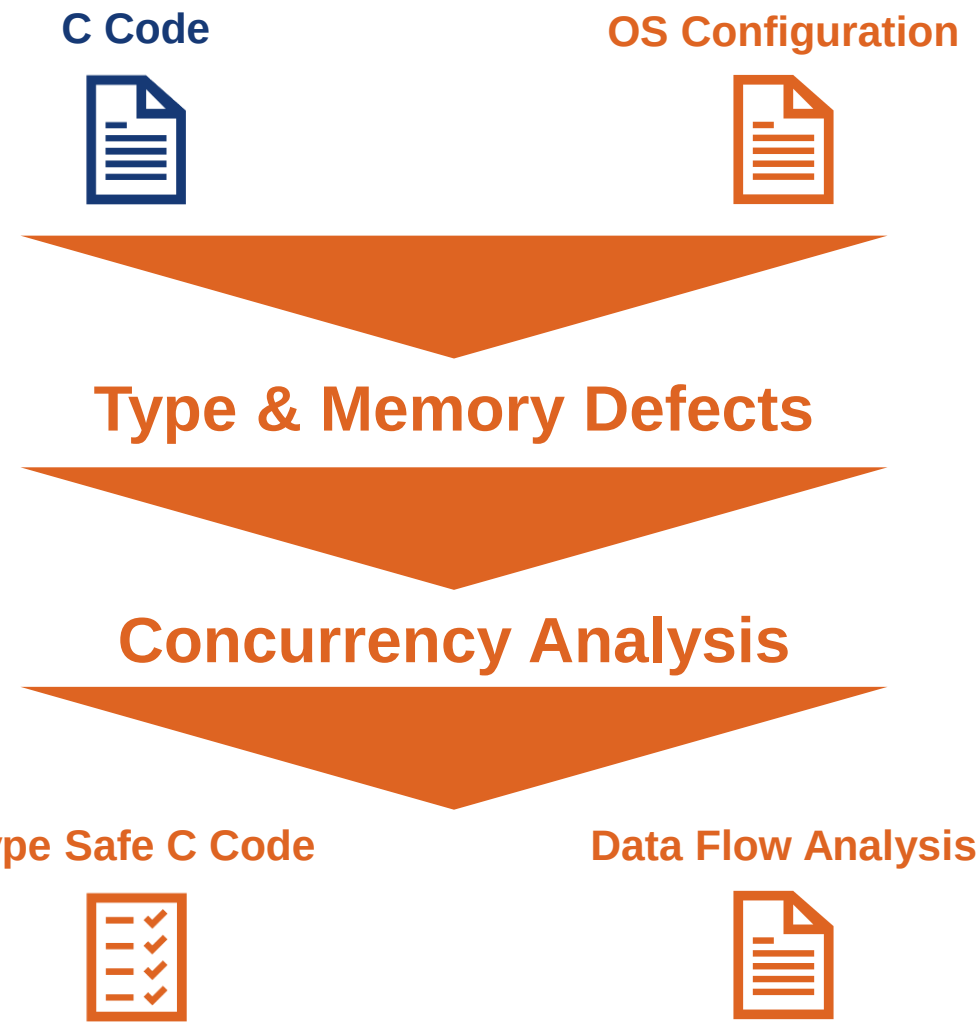
C Code
OS Configuration
Type & Memory Defects
Concurrency Analysis
Type Safe C Code
Data Flow Analysis

Astrée

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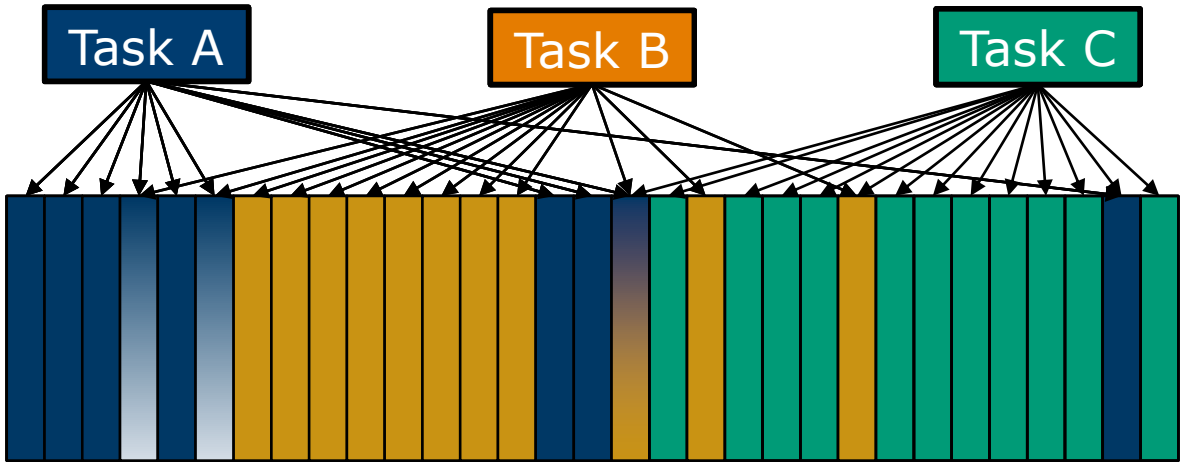
```
int a[ARRAY_LEN];
int x = -10;
for(int i = 0; i <= ARRAY_LEN; i++) {
   a[i] = 0;
}
```

Out-of-bounds Array Access



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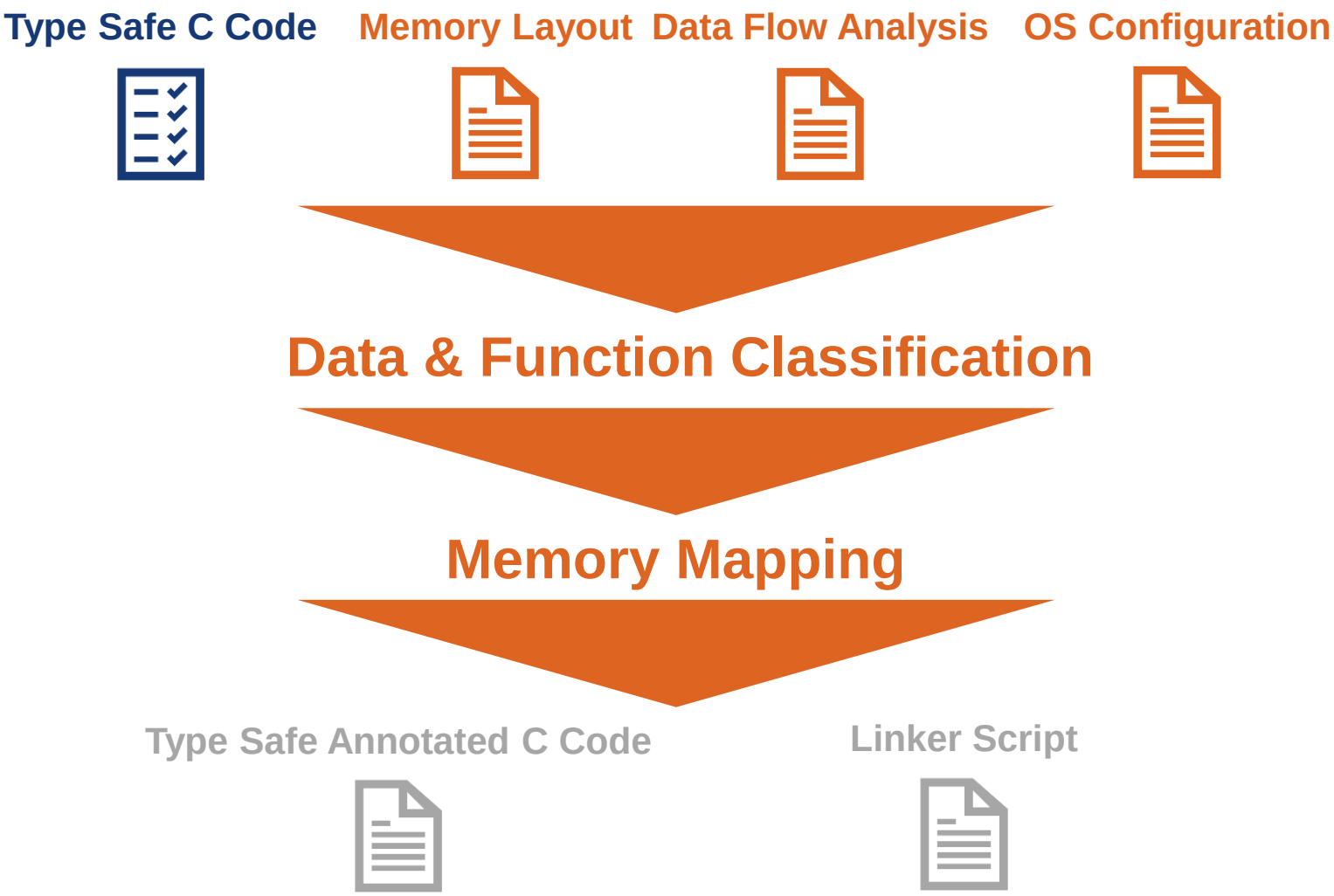
Type Safe C Code
Memory Layout
Data Flow Analysis
OS Configuration
Data & Function Classification
Memory Mapping
Type Safe Annotated C Code
Linker Script

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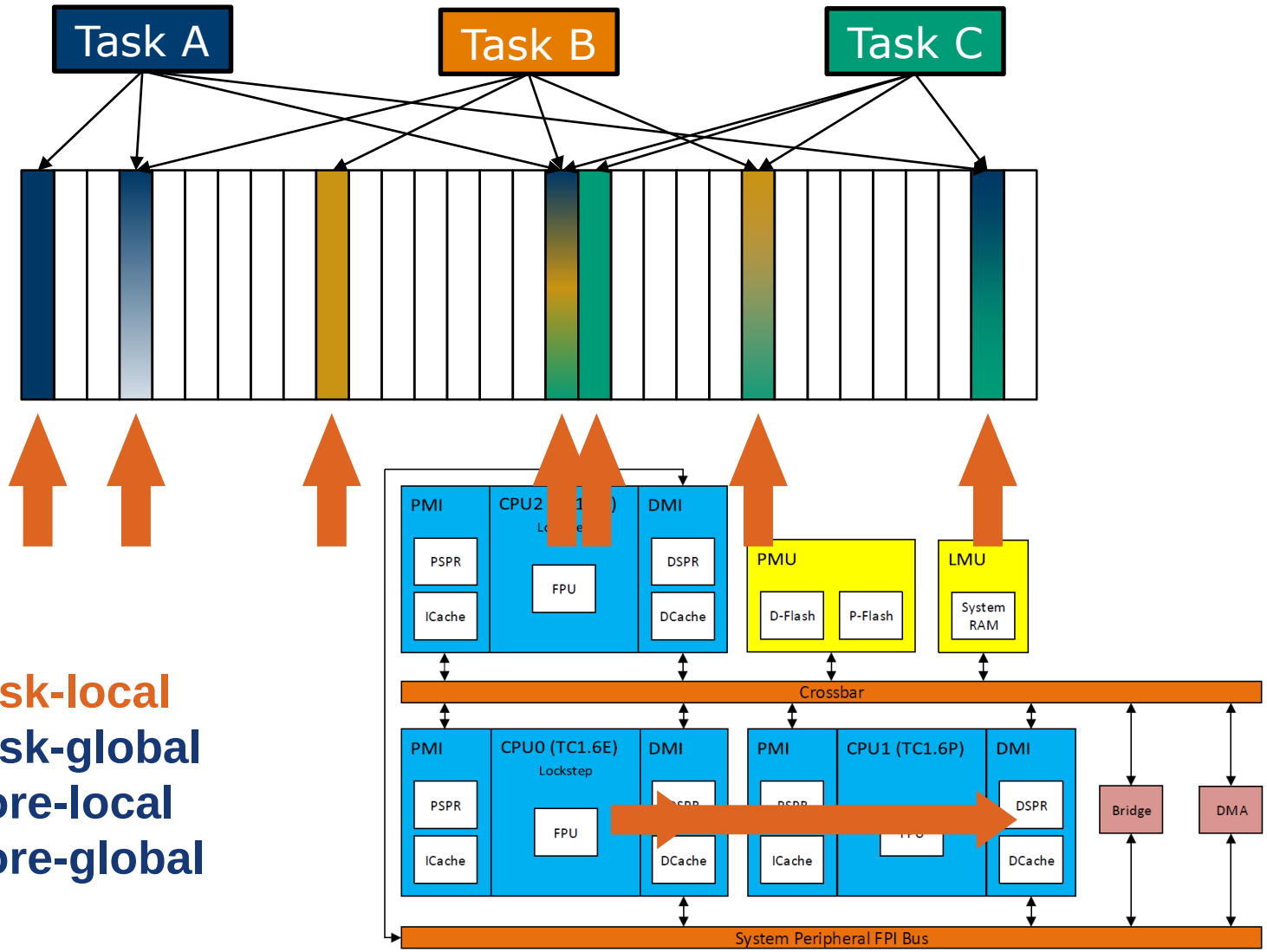

- **Task-local**
- **Task-global**
- **Core-local**
- **Core-global**

Summary

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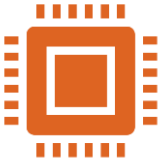
Software Platform

Adapting

Specific Product

Run Time Efficiency

Memory Efficiency



Specialized Hardware

Temporal Isolation

Spatial Isolation

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