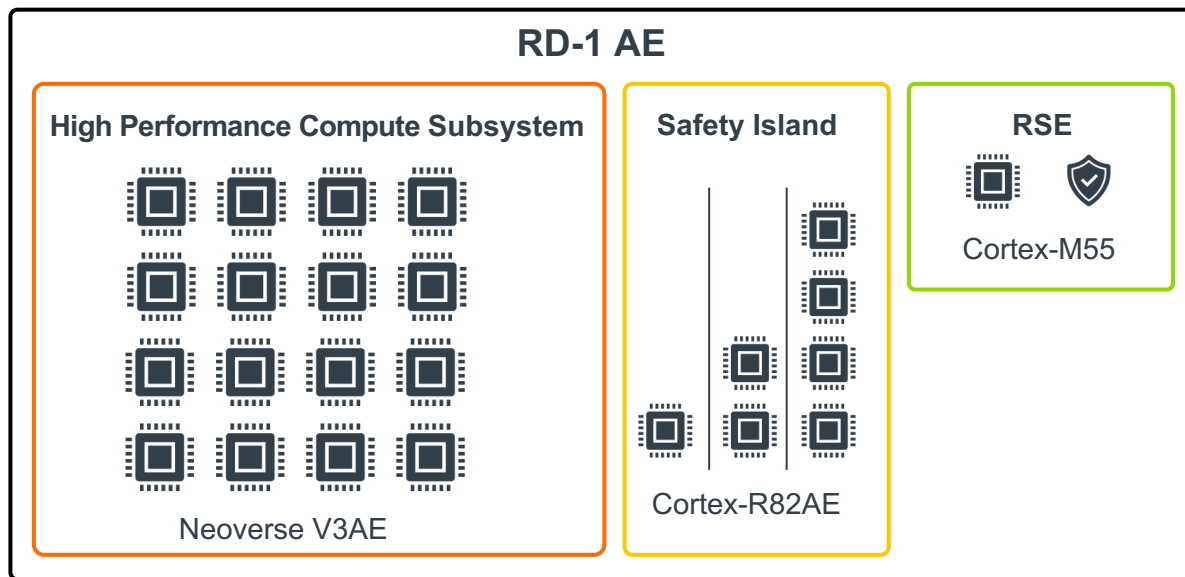# Arm Automotive update

Ed Doxat – Arm
Filipe Rinaldi - Arm

Reference Design-1 AE (RD-1 AE)

- In March 2024 Arm released a collection of Automotive Enhanced IP products
  - Neoverse V3AE core
  - Cortex-R82AE
  - NI-710AE
  - GIC-720AE
- RD-1 AE delivers system guidance showing a high-performance compute system extended with additional safety features for Automotive use cases
- Available via a Fixed Virtual Platform (FVP) and example base software
- Safety features provided through a combination of dedicated hardware in the system Safety Island, and software services
- Software packaged with Yocto recipes

RD-1 AE Architecture Overview

RD-1 AE

High Performance Compute Subsystem

Neoverse V3AE

Safety Island

Cortex-R82AE

RSE

Cortex-M55

Arm Automotive Enhanced IP

- V3AE
- Cortex-R82AE
- NI-710AE
- GIC-720AE

Main RD-1 AE features

- RSE driven secure boot
- Multi domain Cortex-R82AE based Safety Island with NI-710AE interconnect and GIC-720AE:
  - Application monitoring service for Neoverse V3AE hosted applications
  - High reliability compute subsystem for ASIL-D workloads
  - Handling of system fault signals
- Transport Layer Security (TLS) with RSE hardware cryptography support
- RSE secure services providing PSA Secure Storage and Crypto compliant APIs
- Arm SystemReady IR aligned software stack for Neoverse V3AE
- Secure firmware update following Arm's Security Firmware Update Specification
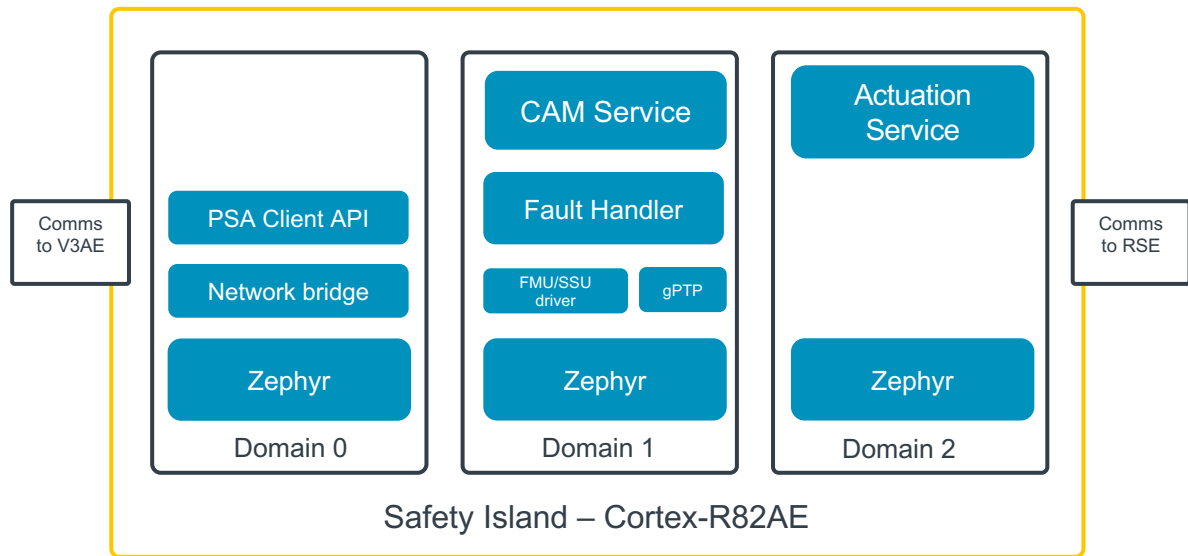- Type-1 hypervisor integration for Neoverse V3AE hosted applications

System boot

RSE

SCP

Safety
Island
domains

Primary
Compute
Firmware
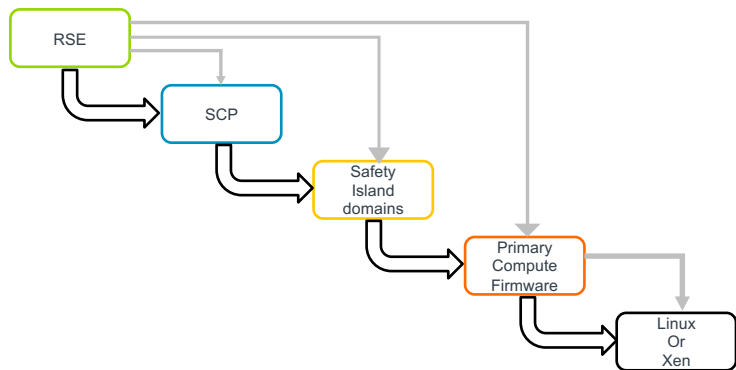
Linux
Or
Xen

Legend

Boot flow

Image load

- Boot sequence similar to traditional system boot
- RSE provides images for SCP, Safety Island and first stage Primary Compute firmware
- Linux or Xen Type 1 Hypervisor started as final stage
- Safety Island runtime available to execute system health checks before Primary Compute

Safety Island overview

Comms to V3AE

Domain 0	Domain 1	Domain 2
PSA Client API	CAM Service	Actuation Service
Network bridge	Fault Handler	
	FMU/SSU driver	gPTP	
Zephyr	Zephyr	Zephyr

Safety Island – Cortex-R82AE

Comms to RSE

Separate domains for improved freedom from interference

- **Domain 0 :**
  IO scheduling and network relay
- **Domain 1 :**
  Safety oversight
- **Domain 2 :**
  ADAS workload module deployment

Critical Application Monitoring (CAM)

- System software feature for detection of software errors caused by "stuck at" hardware faults on Neoverse V3AE Primary Compute (PC) subsystem
- Monitoring service runs on Safety Island as Zephyr RTOS application
- Application being monitored communicates health messages over IP socket, via system MHU hardware connection to SI
- Time sync between SI and PC domain using gPTP
- Can improve overall ASIL level of a system
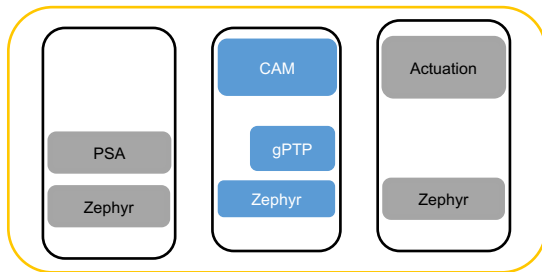
# Critical Application Monitoring (CAM) Project
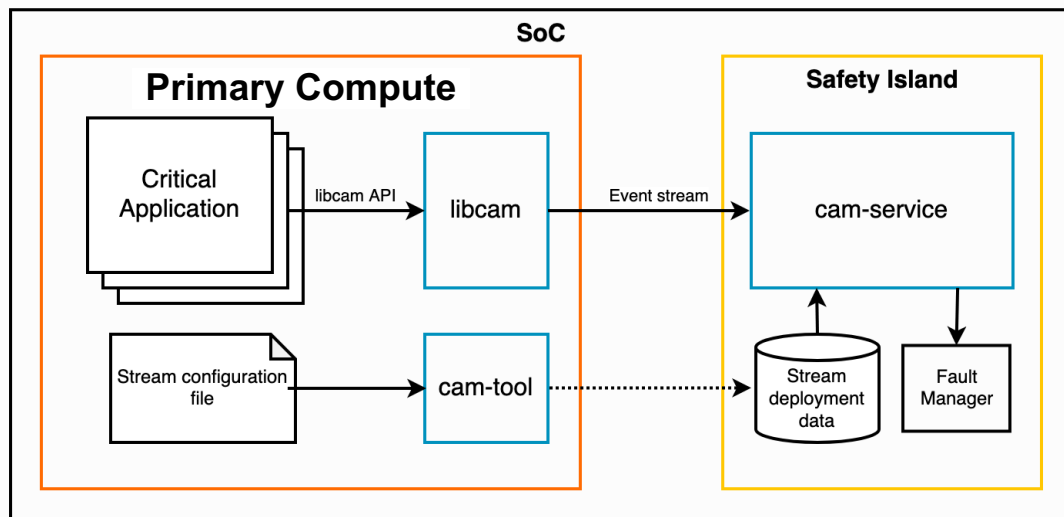
Framework for monitoring safety applications:

- Metadata describing App requirements deployed in the Safety Island
- Apps are instrumented using **libcam**
- Apps generate events throughout their execution
- **Cam-service** tracks the events to detect both temporal and logical issues

Safety Island ASIL-D compute environment

- Cortex-R82AE cores provide increased reliability compute with split/lock modes and enhanced error detection at hardware level
- ADAS workloads can run safety critical segments (e.g. actuation control messaging) on SI to satisfy safety requirements
- RD1-AE demonstrates Autoware Pure Pursuit module running as Zephyr application on SI
- Separate demonstration available of full Autoware pipeline with Rviz, and Pure Pursuit on NXP S32Z (Cortex-R52)
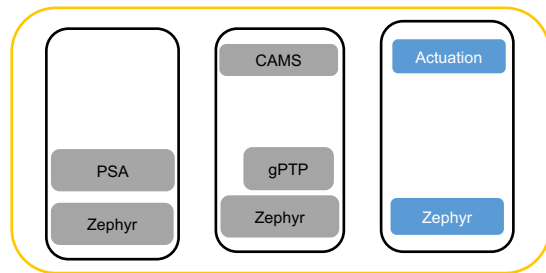
Fault Handling

- Fault signals aggregated via System Fault Monitoring Unit (SFMU) in Safety Island
- Unlike RAS, errors are not handled via firmware or BMC
- System Safety Unit (SSU) exports signals for implementation defined handling
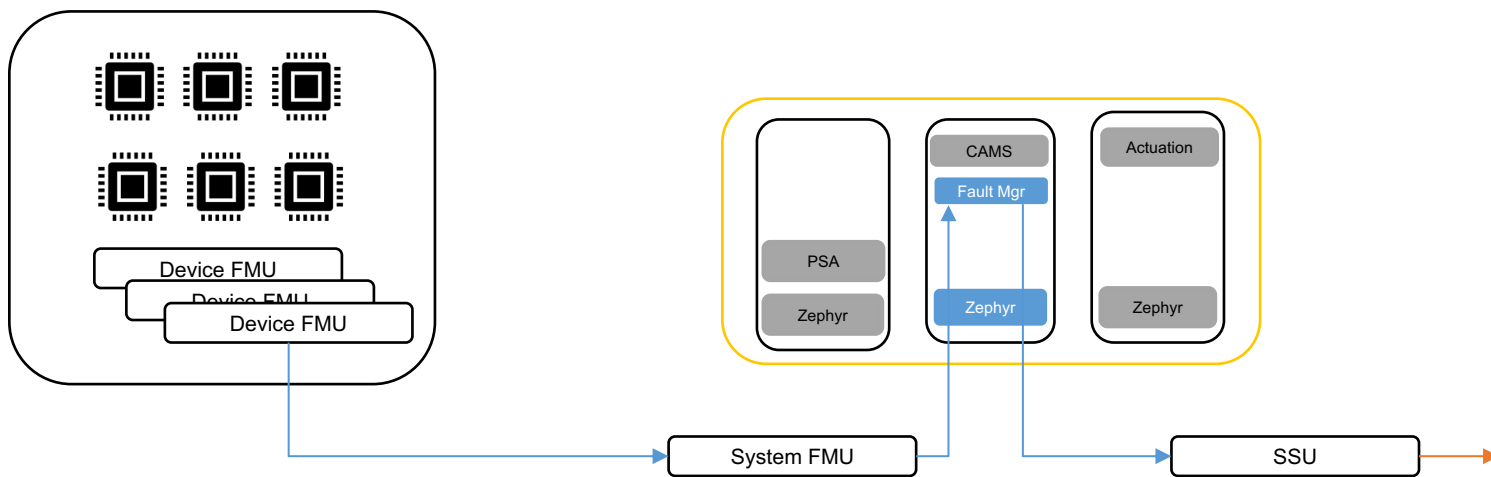
Other system features

- Type 1 Hypervisor for Primary Compute
- Virtual networking with OpenAMP and VirtIO for Safety Island and Primary Compute comms
- RSE and PARSEC runtime services
- RSE secure storage and TLS
- EWAOL integration coming soon

Linaro Connect
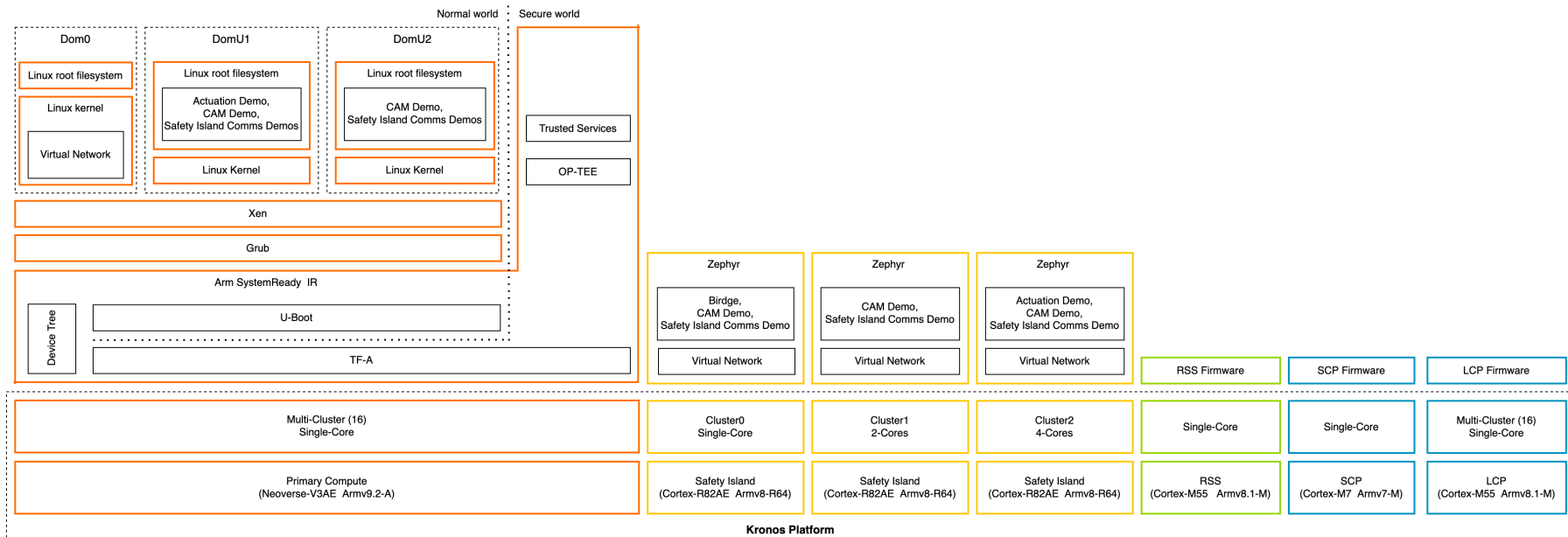
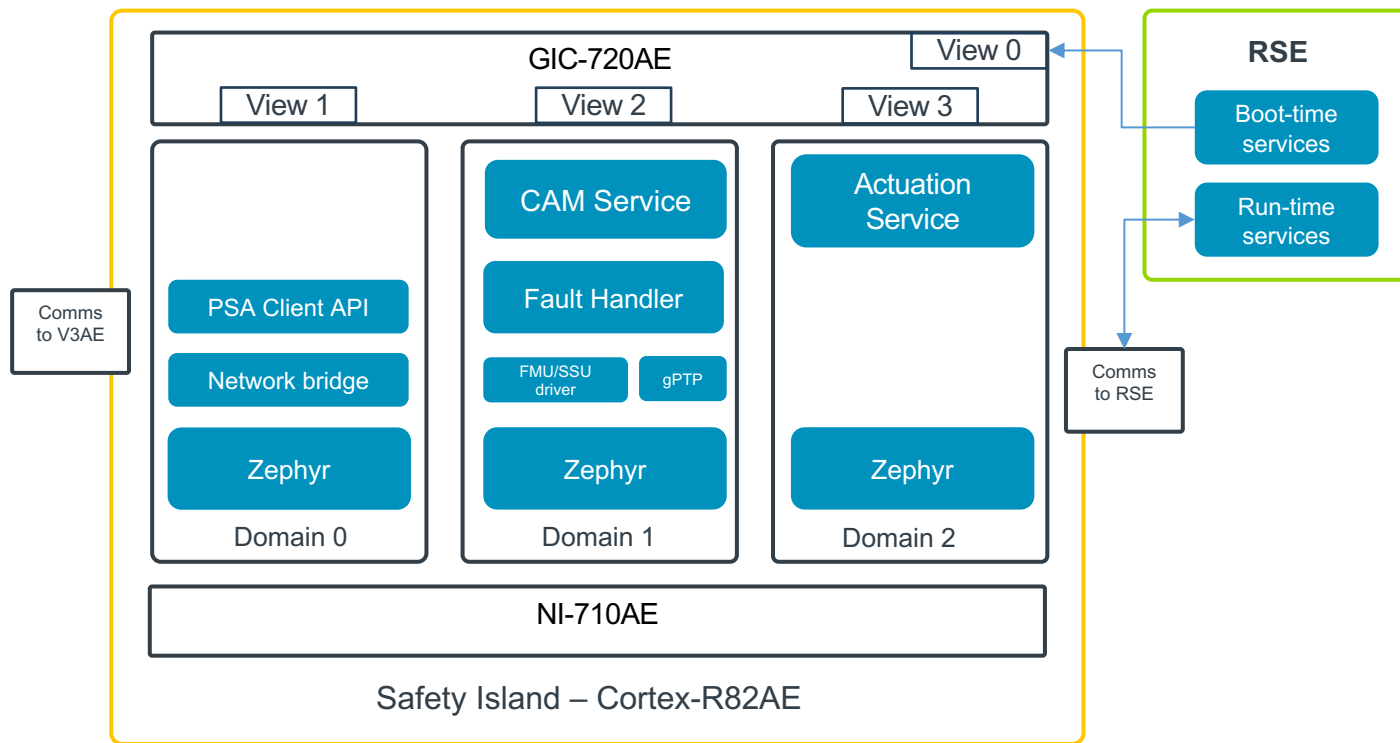MADRID 2024 | MAY 12-17 2024

Thank you

Additional Information

Main software changes

- Arm Firmware:
  - OP-TEE
  - Runtime Security Engine (RSE)
  - System Control Processor (SCP) Firmware
  - Local Control Processor (LCP) Firmware
  - Trusted Firmware-A (TF-A)
  - Trusted Services
- U-boot
- Xen Hypervisor
- Zephyr

System overview

Safety Island overview

Resources

AE IP release blog
- https://newsroom.arm.com/blog/automotive-enhanced-ip-portfolio

RD-1AE
- https://developer.arm.com/Tools%20and%20Software/Arm%20Reference%20Design-1%20AE

Neoverse V3AE
- https://developer.arm.com/Processors/Neoverse%20V3AE

Cortex-R82AE
- https://developer.arm.com/Processors/Cortex-R82AE

NI-710AE
- https://developer.arm.com/documentation/102756/0001/CoreLink-NI-710AE-Network-on-Chip-Interconnect/Product-documentation

Resources (cont.)

RD-1 AE Reference Software Stack

- https://kronos-ref-stack.docs.arm.com/en/latest/

Critical Application Monitoring

- https://critical-app-monitoring.docs.arm.com/en/latest/index.html