

The background features a futuristic, glowing purple and blue car with a grid overlay, set against a dark, digital environment. A vertical cyan line runs through the center of the image. The overall aesthetic is high-tech and futuristic.

arm

Xen on the Arm[®] RD-1 AE

Running Xen on the latest Arm Automotive
platform design

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Outline

- Introduction to the RD-1 AE platform
- Software architecture
- Xen on RD-1 AE
 - Heterogeneous Inter-Processor Communication
 - Network topology
- Arm features in Xen
 - GICv4.1 + PCI passthrough
 - MPAM
 - SVE
- Testing
- Links

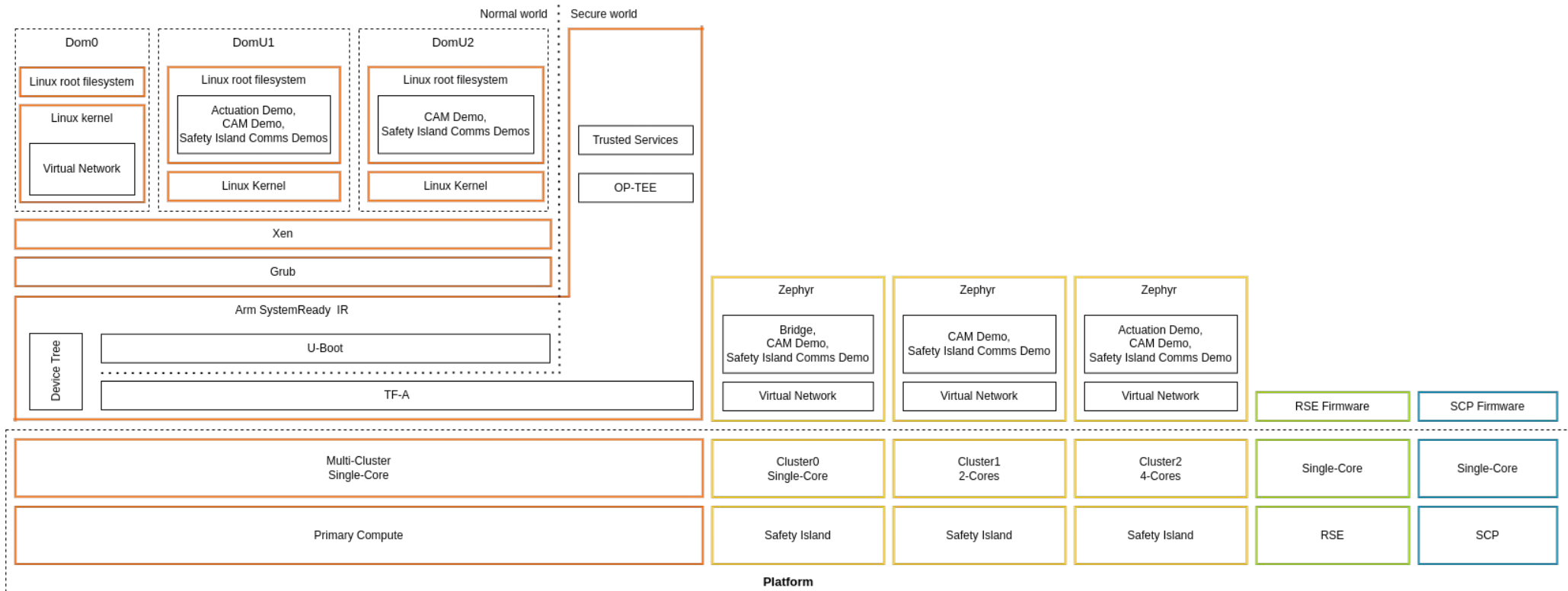
Introduction to the RD-1 AE

- The Arm Reference Design-1 AE, or RD-1 AE introduces few concept:
 - Primary Compute
 - High-performance Arm® Neoverse™ V3AE Application Processors (Armv9.2-A)
 - Safety Island
 - 3 clusters of Arm® Cortex®-R82AE (Armv8-R AArch64)
 - Runtime Security Engine (RSE)
 - Cortex-M55 (Armv8.1-M)
- A Fixed Virtual Platform (FVP) is available as part of the Reference Design.
 - <https://developer.arm.com/downloads/-/arm-ecosystem-fvps>

Software architecture

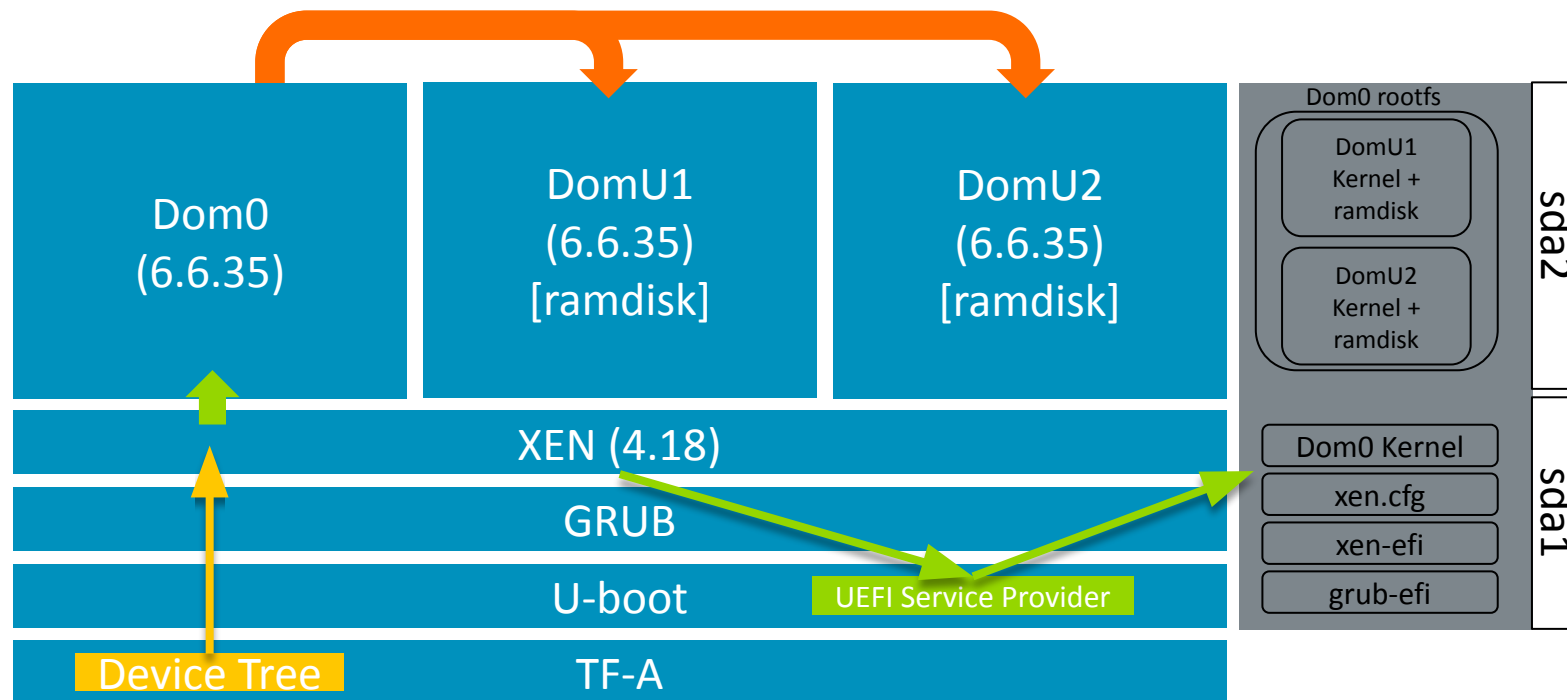
- The SW stack implements a Baremetal and a Virtualization Architecture
 - Focus on the Virtualization Architecture

Arm Automotive Solutions High-Level Diagram - Virtualization Architecture



Xen on RD-1 AE

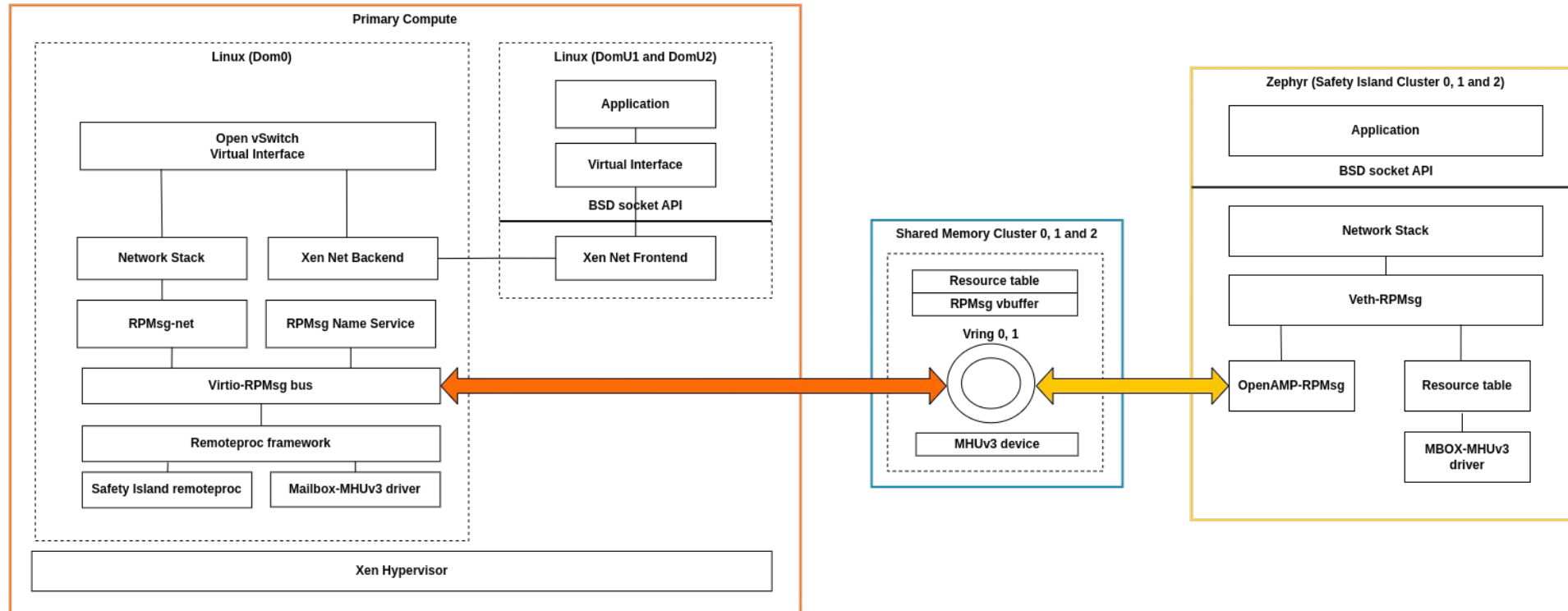
- Xen is started by the U-boot -> GRUB chain
- UEFI Xen stub uses the UEFI provider to read the disk and load Dom0 Kernel
- Once the Dom0 Kernel is started, DomU1 and DomU2 are started using XL



Xen on RD-1 AE - HIPC

- Custom Linux driver for Heterogeneous Inter-Processor Communication for Dom0:
 - DomU1 and DomU2 uses PV network drivers

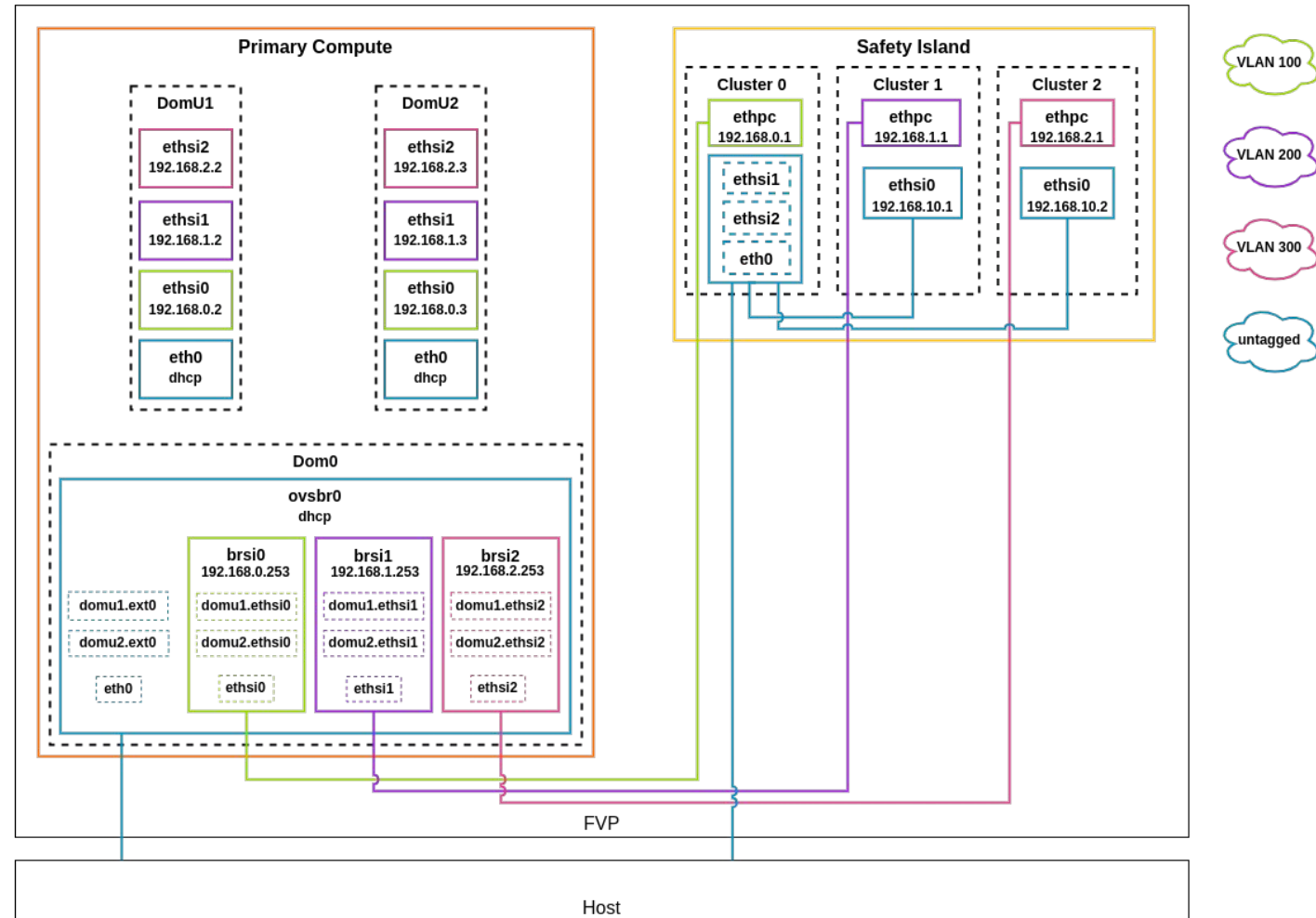
Arm Automotive Solutions HIPC - Virtualization Architecture



Xen on RD-1 AE – Network Topology

- Dom0 runs Open vSwitch:
 - Network bridges
 - VLAN traffic
- Safety Island Clusters have different VLAN IDs
 - Ethsi<X> and eth0 are for development purpose only
 - Every DomU can reach every cluster, but depending on the use-case it can be restricted

Arm Automotive Solutions Network Topology - Virtualization Architecture



Arm features in Xen

- MPAM

- Provide MPAM support for the System Level Cache (L3) partitioning
- Dom0 has $\frac{1}{4}$ of the available SLC portions
- DomU1 and DomU2 has $\frac{1}{8}$ respectively of the available SLC portions
- Partitions are for demonstration purpose only

```
root@fvp-rd-kronos:~# xl psr-cat-show -l 0
Socket ID      : 0
SLC            : 32768KB
Default CPBM   : 0xffff
ID            NAME            CPBM
0             Domain-0        0xf
1             domu1         0xc0
2             domu2         0x30
```

- GICv4.1 + PCI Passthrough

- DomU1 has a PCI AHCI SATA Disk attached to it

```
root@domu1:~# lspci
00:00.0 Class 0106: 0abc:aced
```

- SVE/SVE2

- The Neoverse™ V3AE Application Processors is SVE/SVE2 capable, Dom0 and the guests can use SVE/SVE2 instructions
- Maximum vector length is 128 bit (16 byte)

```
root@domu1:~# cat /proc/sys/abi/sve_default_vector_length
16
```


Testing

- The SW stack is built using Yocto, the testing is performed using Yocto OEQA
 - Based on Python unittest
 - Performs tests on the FVP platform
 - Uses Pexpect library to interact with the platform
- Testing examples:
 - Test case that checks Dom0 has boot to shell, performs the login and uses xl console <dom> to test that the DomUs reaches the prompt and the shell.
 - Test case that checks PCI Passthrough is working correctly, starting the system, checking that DomU1 sees the disk (lspci)
 - Test case that checks GICv4.1 vLPI direct injection is working correctly, looking into /proc/interrupts for non-zero MSI-X/IPI0 interrupts
 - Test case that uses BATS in order to validate MPAM configuration is applied on boot and after guests lifecycle management.

Links

- The SW stack can be browsed at:
 - <https://gitlab.arm.com/automotive-and-industrial/arm-auto-solutions/sw-ref-stack>
- The SW stack documentation can be found at:
 - <https://arm-auto-solutions.docs.arm.com/>

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Thank You

Danke

Gracias

Grazie

谢谢

ありがとう

Asante

Merci

감사합니다

धन्यवाद

Kiitos

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