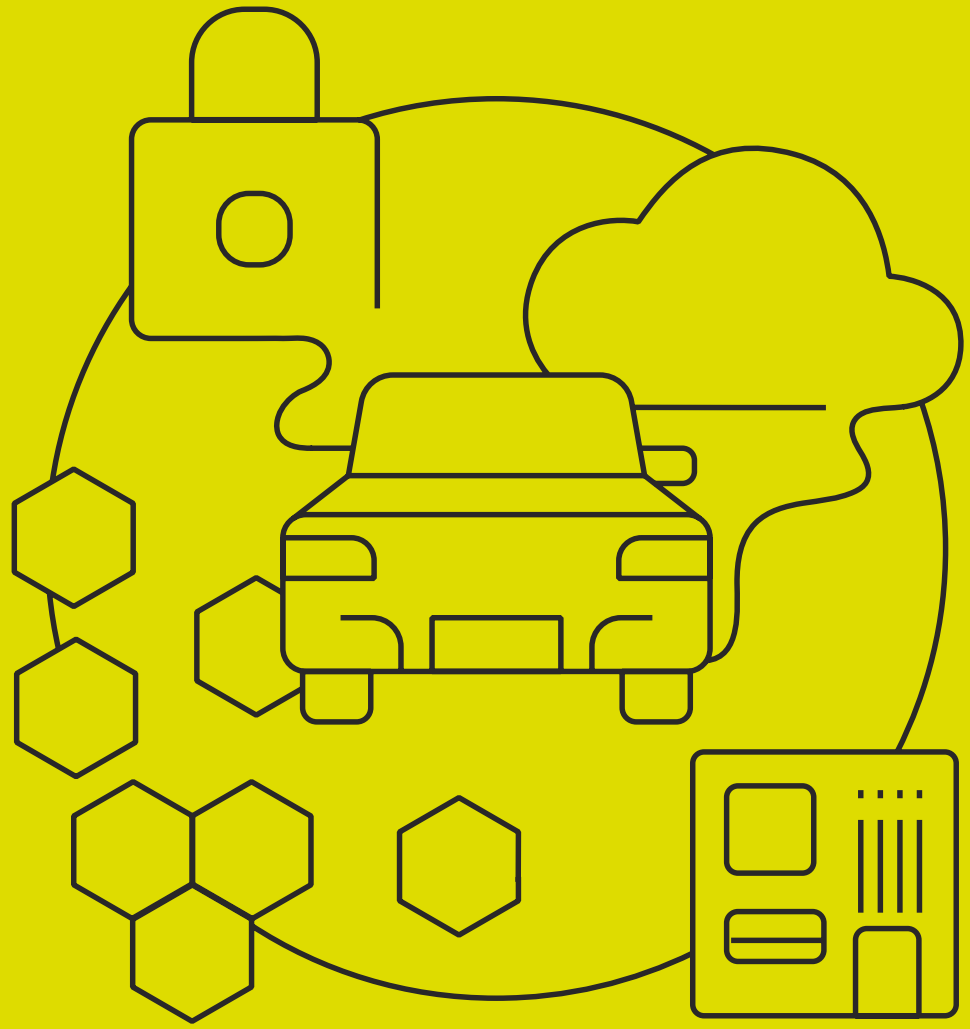
SOAFEE

Investigating Foundational Technologies for Cross-Domain Computing in Intelligent Vehicles



Ding Wang **Black Sesame Technologies. Inc.**

2024-4-22

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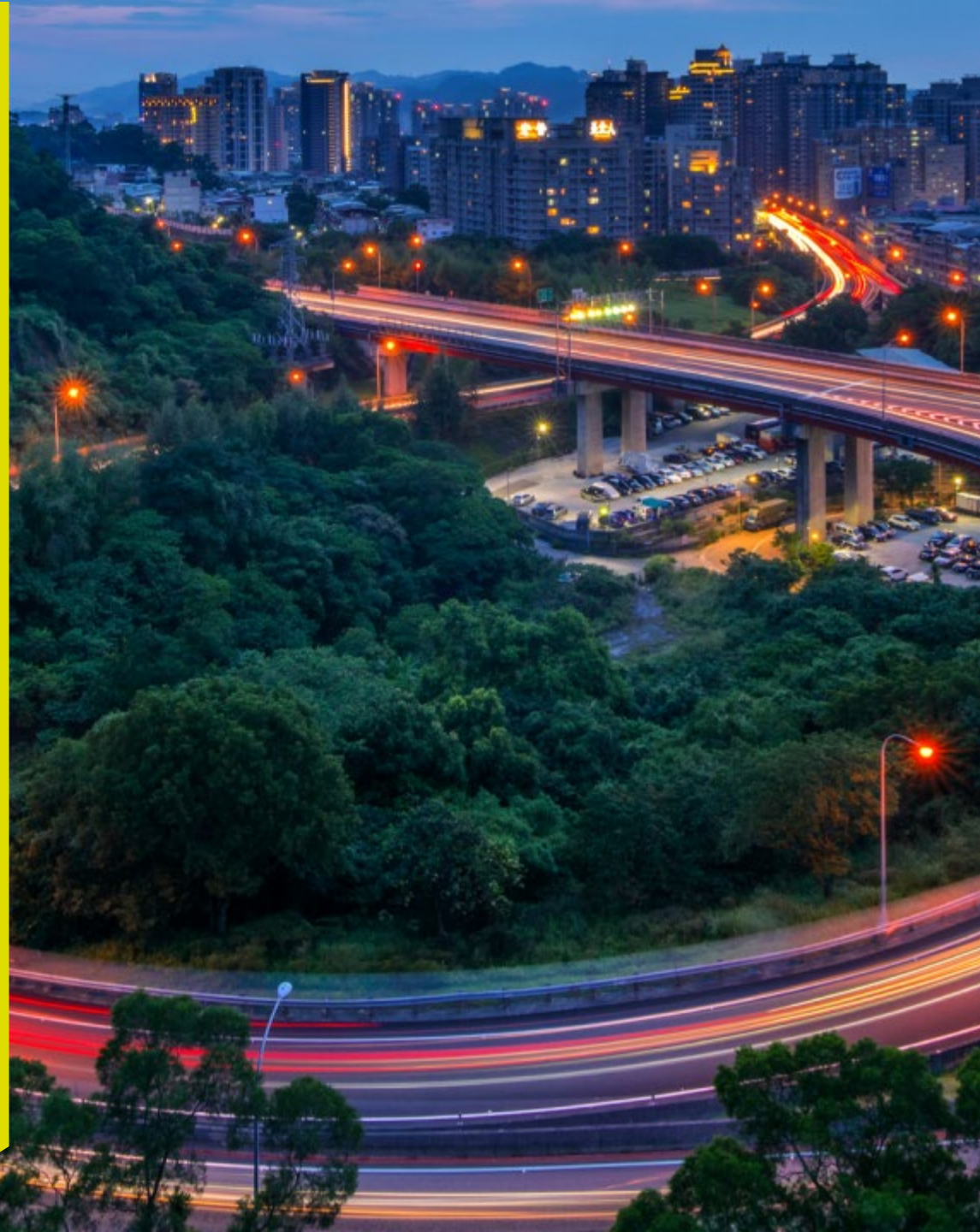
Cross-Domain Communications

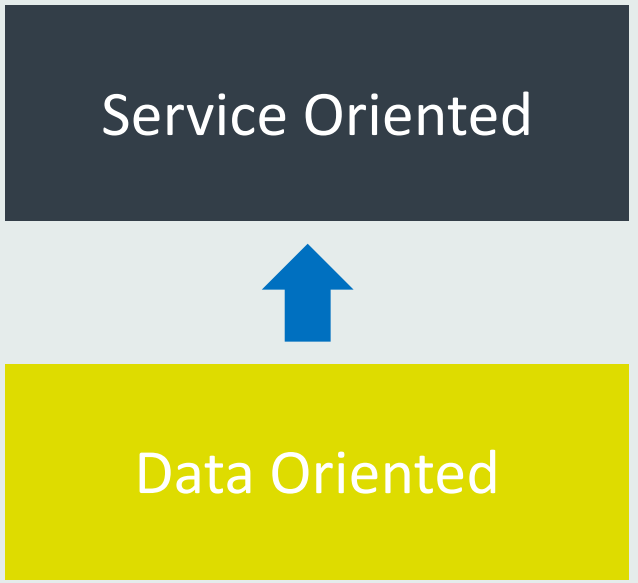


Communication

Available technologies

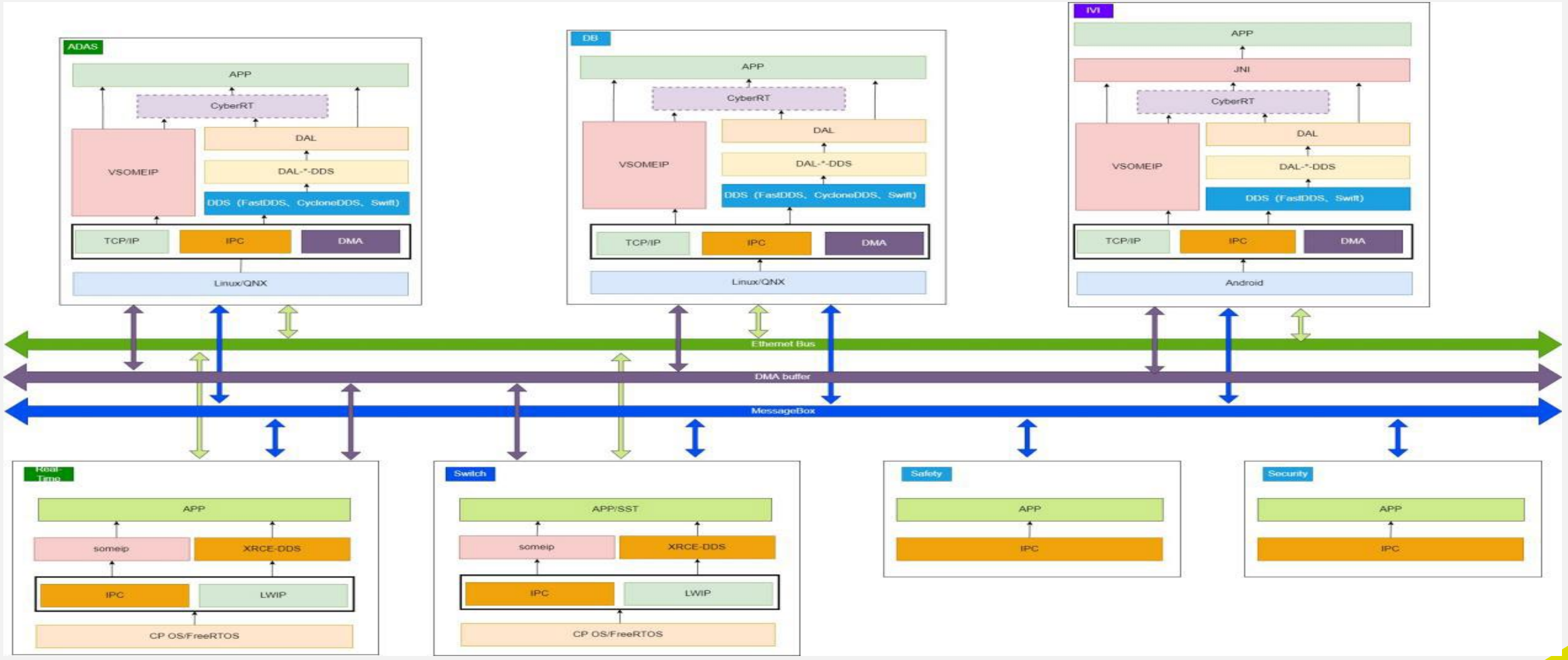
- → Ethernet
  - TCP/IP based private protocol
  - Some/IP
  - DDS
- → Cross-VM Communication
  - Shared memory based
  - Message queue based
- → Inter Processor Communication
  - Message based

Practice on C1200 Family



Communication

Practice on C1200 Family



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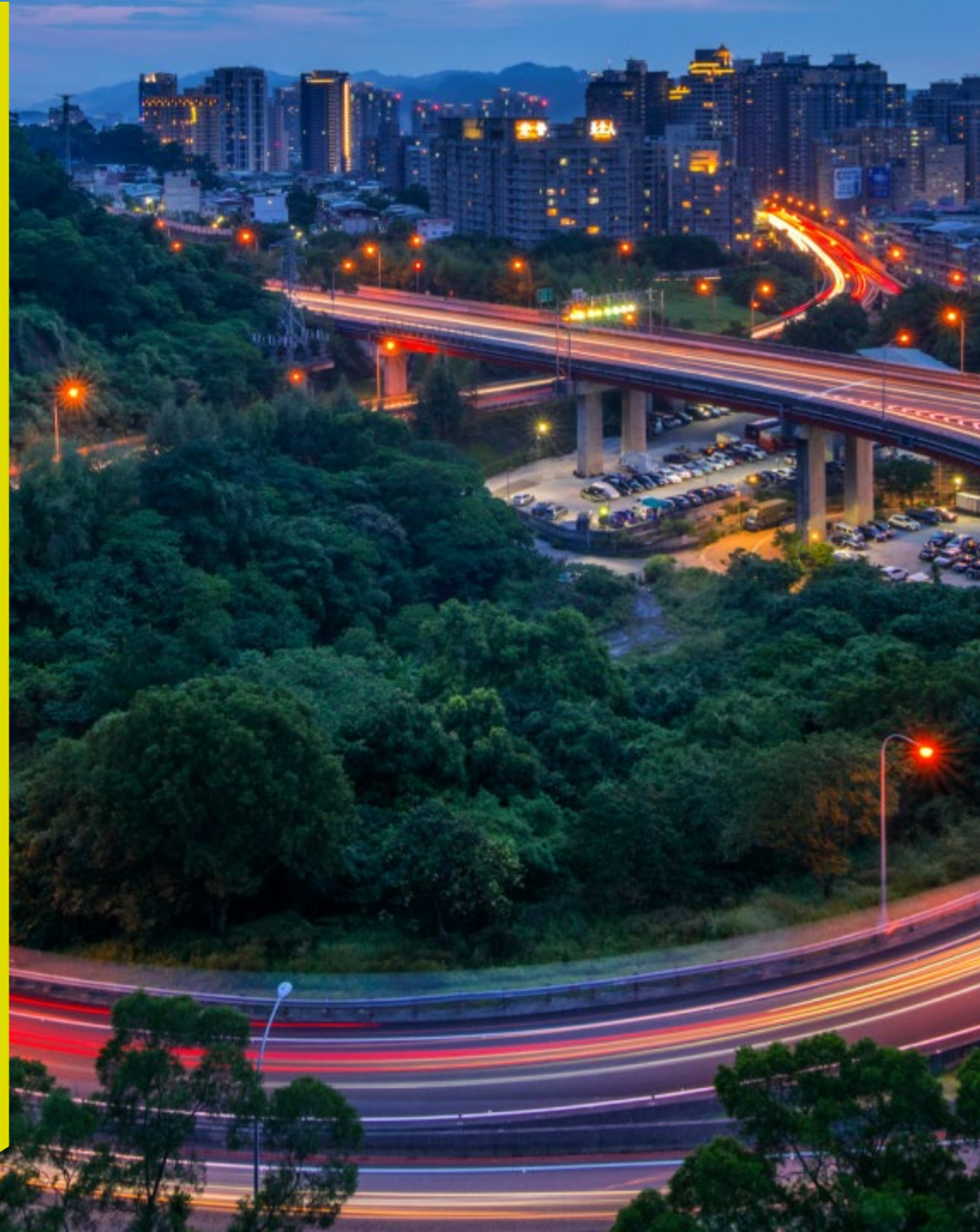
Cross-Domain Shared Memory Mgmt.



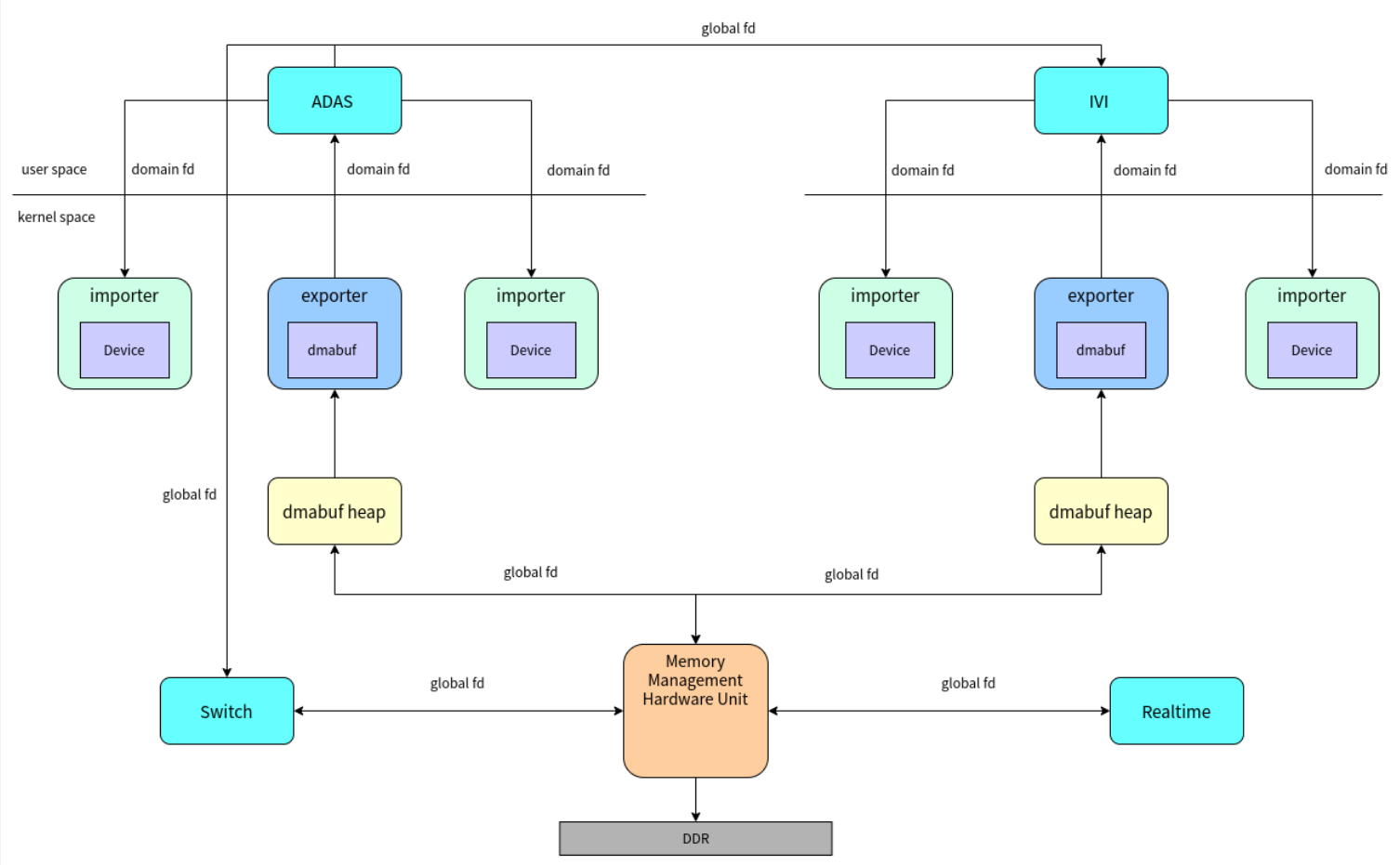
Shared Memory Mgmt.

Shared Memory Mgmt.

Practice on C1200 Family

Architecture

- → Hardware Mgmt. Unit
- → Cross-Domain FD
- → Specified dma-buf-heap
- → Direct access by FD

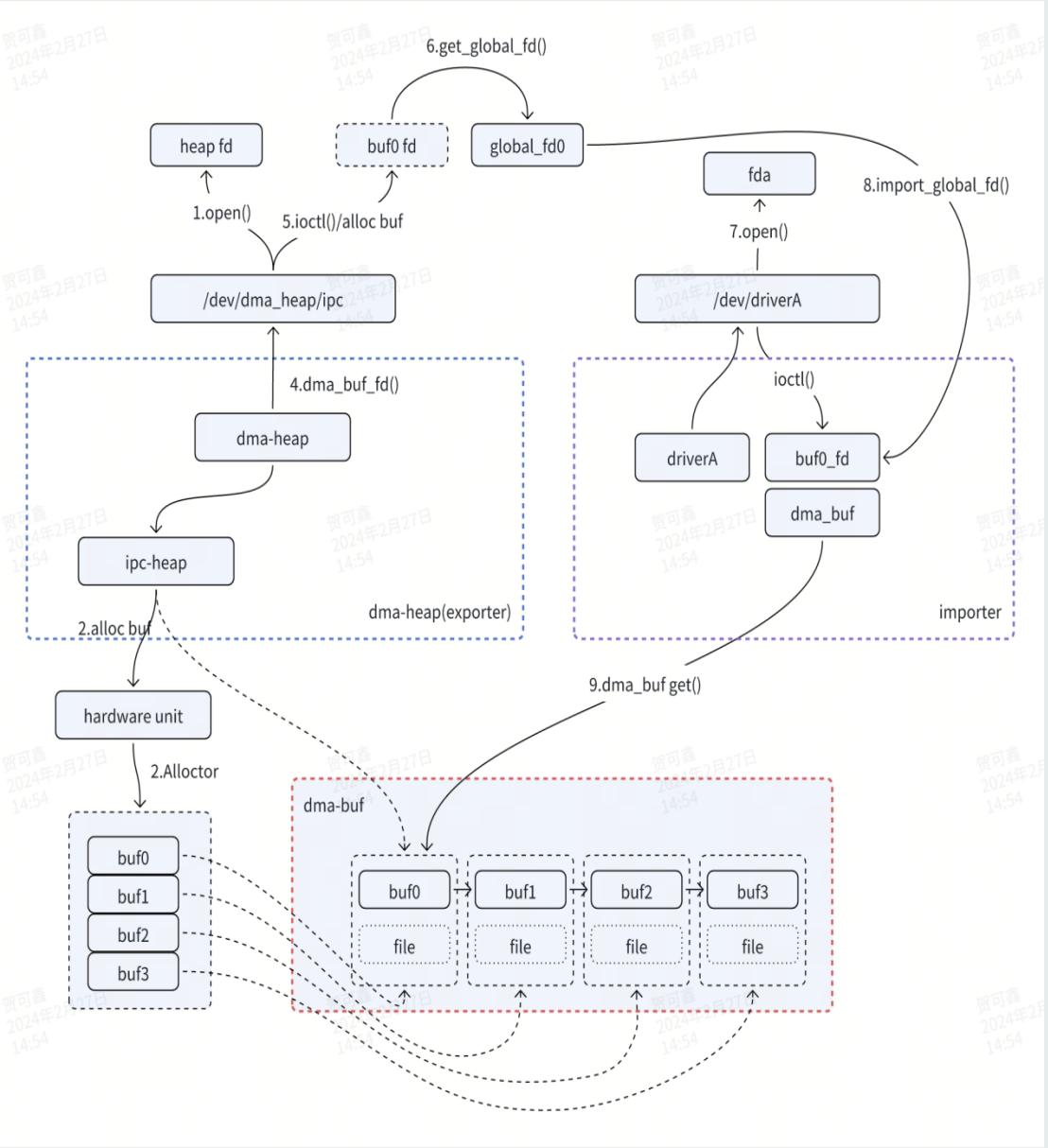


Shared Memory Mgmt.

Practice on C1200 Family

Workflow

→ Allocate from HW Mgmt. Unit.
→ Mapping to FD
→ Global FD Passing
→ Get by FD from HW Mgmt. Unit



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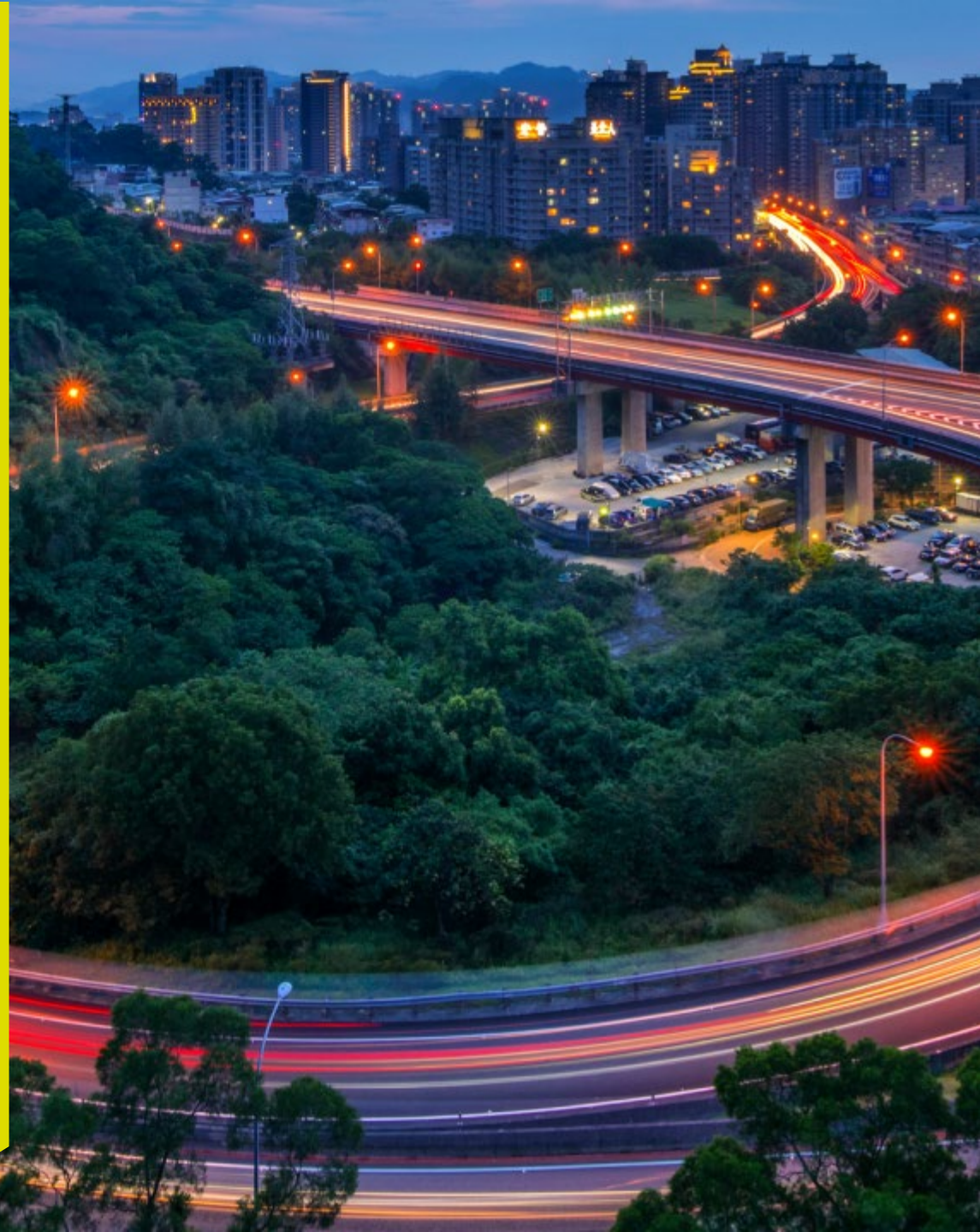
Cross-Domain Static Task Scheduling



Static Task Scheduling

Practice on C1200 Family

Static Deterministic Task Scheduler

- → Static Schedule Table Based
  - Predefined Schedule Point
- → Predictable
  - Predictable execution time
  - Predictable time line
- → Low Cost
  - No cost for runtime scheduling
- → Better Performance
  - Optimized schedule table

Static Task Scheduling

Practice on C1200 Family

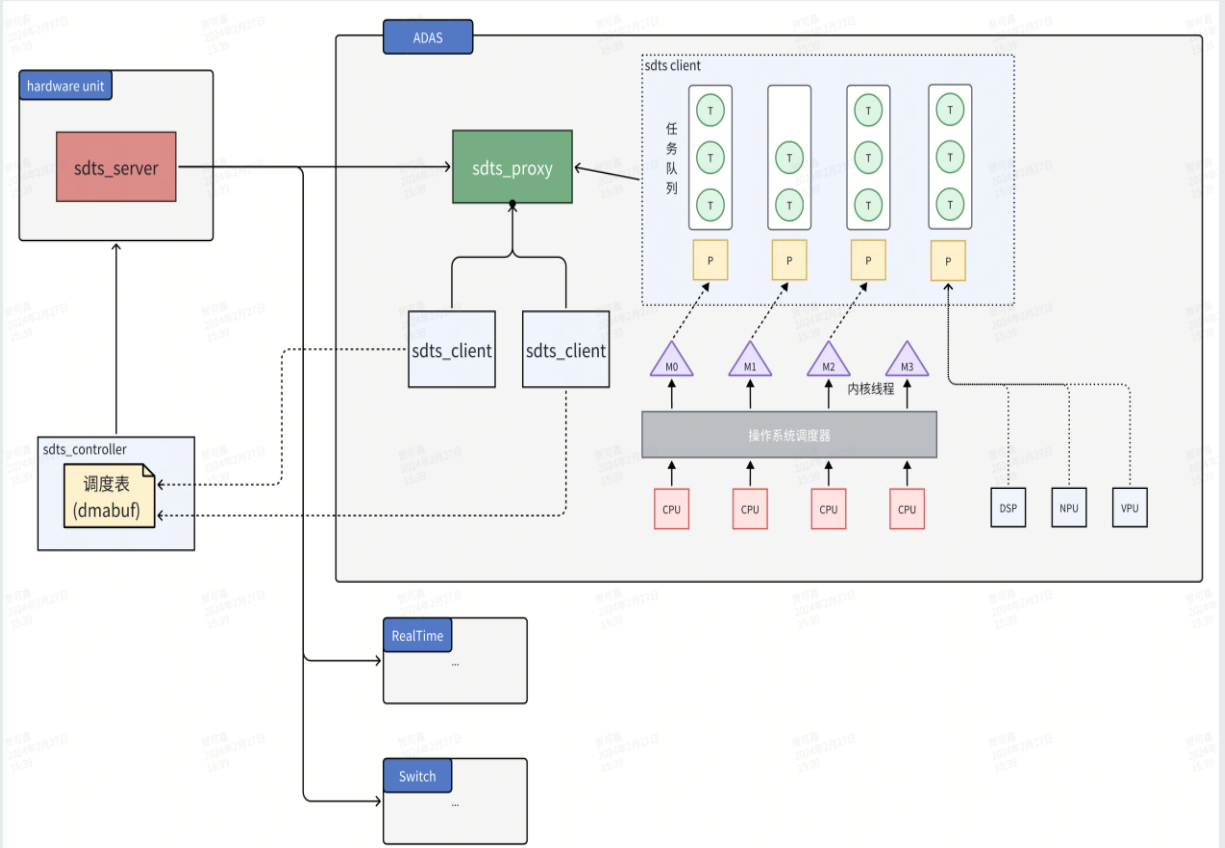
Technical Details

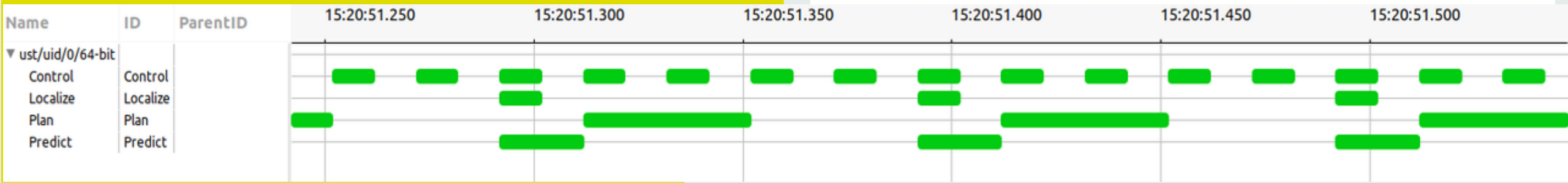
→ Hardware Unit
- Global SDTS Manager

→ SDTS Controller
- Manages static schedule table

→ SDTS Proxy
- Communicate with SDTS server
- Manages SDTS client

→ SDTS Client
- Manages all worker processes





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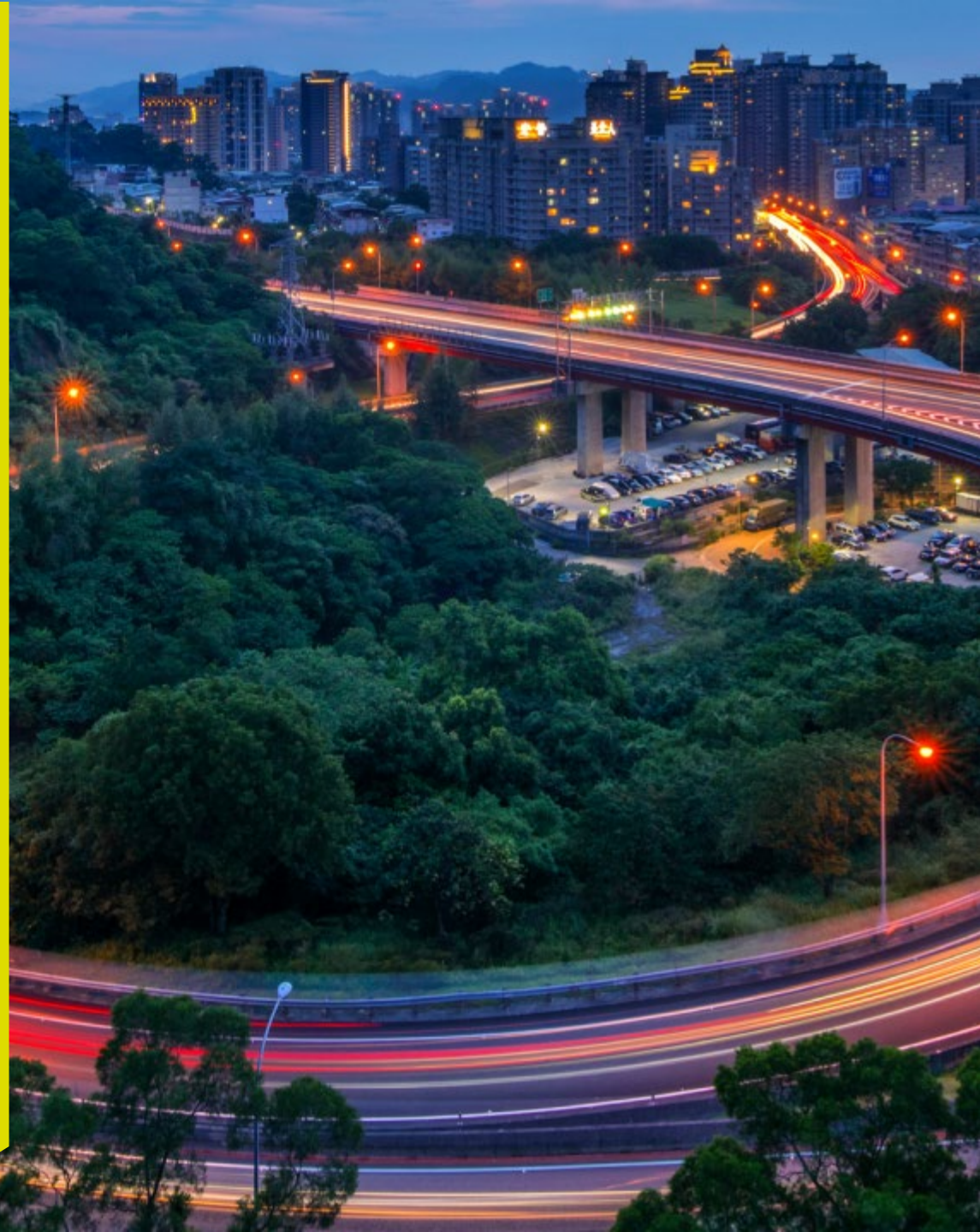
Cross-Domain Shared Device Access



Shared Device Access

Available Technologies

- → Virtualization
  - On same hypervisor
  - With SMMU is better
- → Hardwar Partition
  - Needs hardware support
- → SOA
  - Needs Computing Core

Practice on C1200 Family

- → Virtualization
  - UART
  - SPI
  - …
- → Hardware Partition
  - G78AE
  - UFS
  - …
- → SOA
  - Asymmetric Cores
  - ISP/NPU/DSP…
  - Global Service, e.g. Display

Shared Device Access

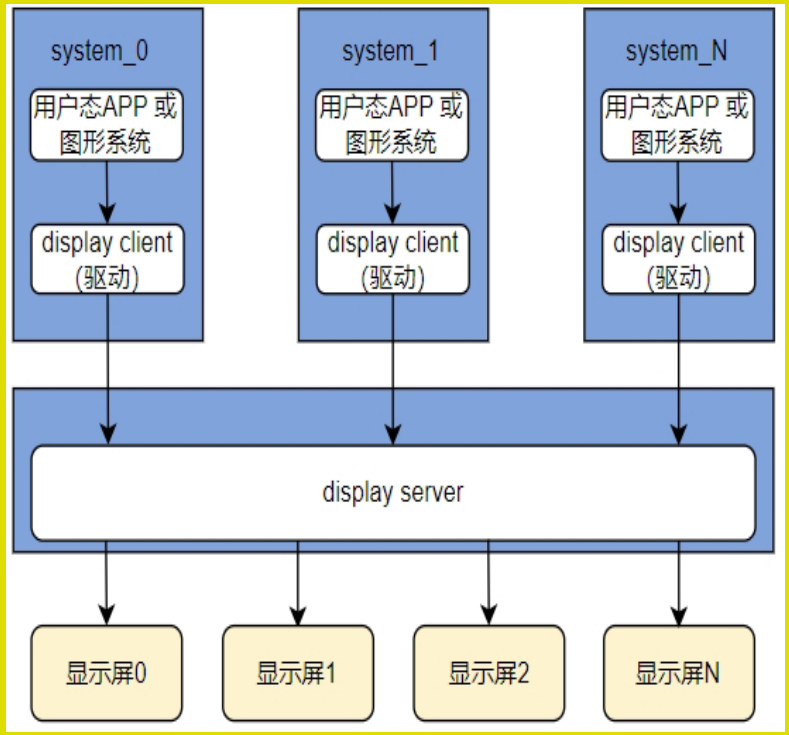
Practice on C1200 Family

Display Arch.

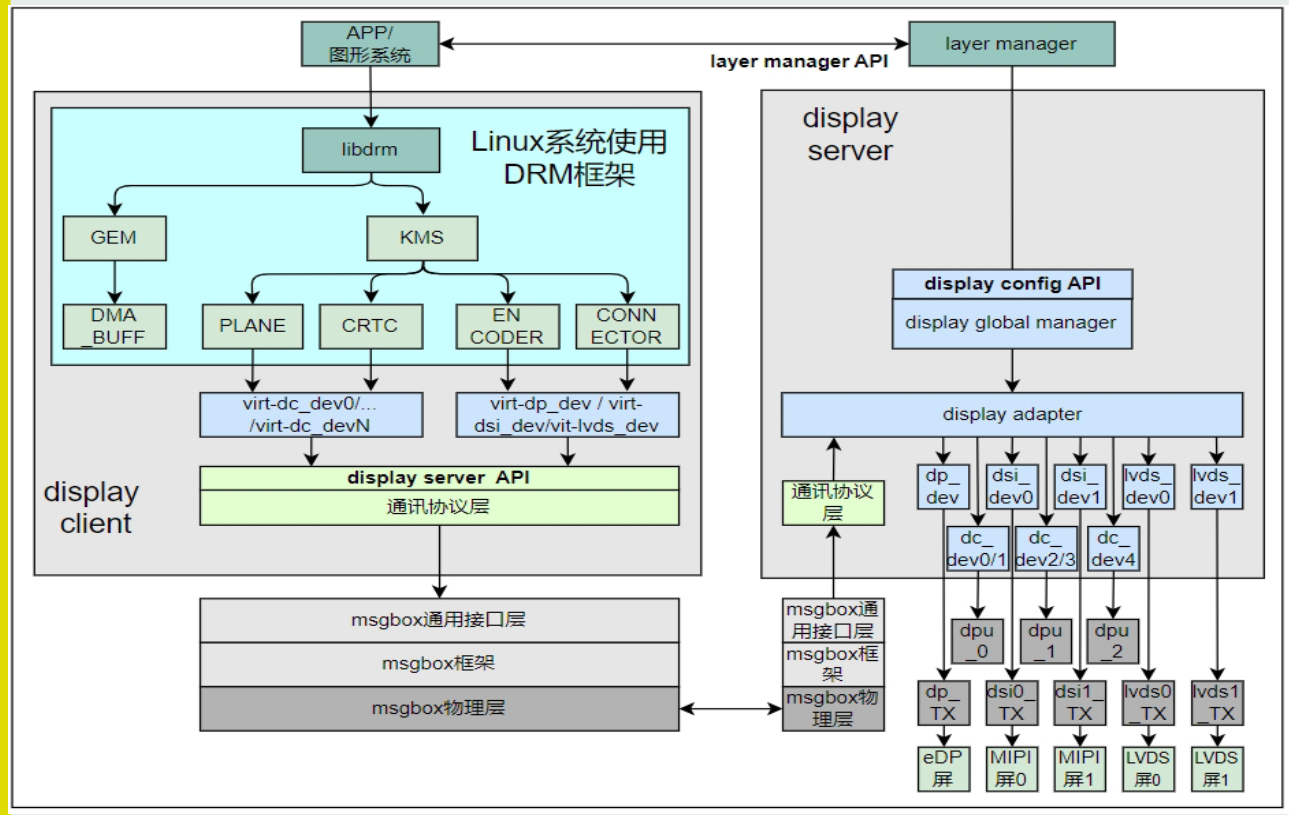
→ Global Display Server

→ Display client in different domain

→ Communicate via msgbox (kind of IPC)



Virtual DRM Arch.



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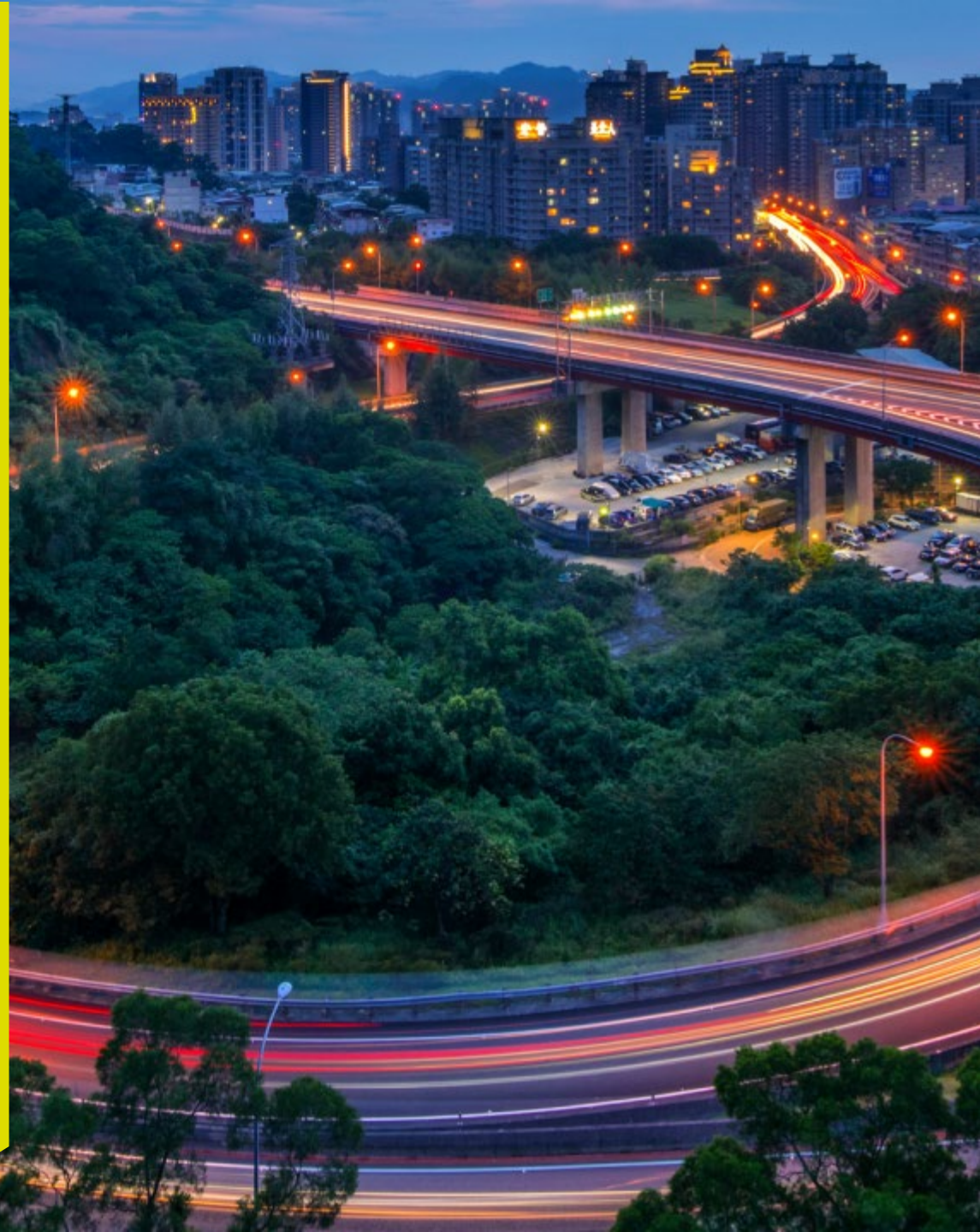
Cross-Domain Containerization



Containerization

Available Technologies

- → Container on Linux
  - Namespace
  - Cgroups
  - Overlay FS
- → Uni-kernel
- → Lite container on Micro-kernel OS
  - Overlay FS
  - Namespace
- → Web Assembly

Practice on C1200 Family

- → Container on Linux
- → Web Assembly
  - Fast
  - Secure
  - Easy Port
  - Suitable for MCU with R cores
- → Deploy web assembly
  - Linux user space
  - Linux kernel space
  - Micro-Kernel OS
  - MCU firmware

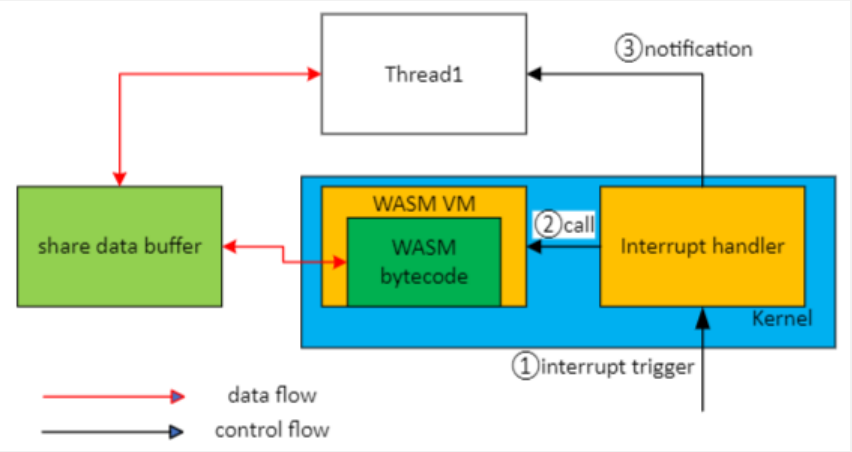
Web Assembly on Micro-Kernel OS

An Example on C1200 Family

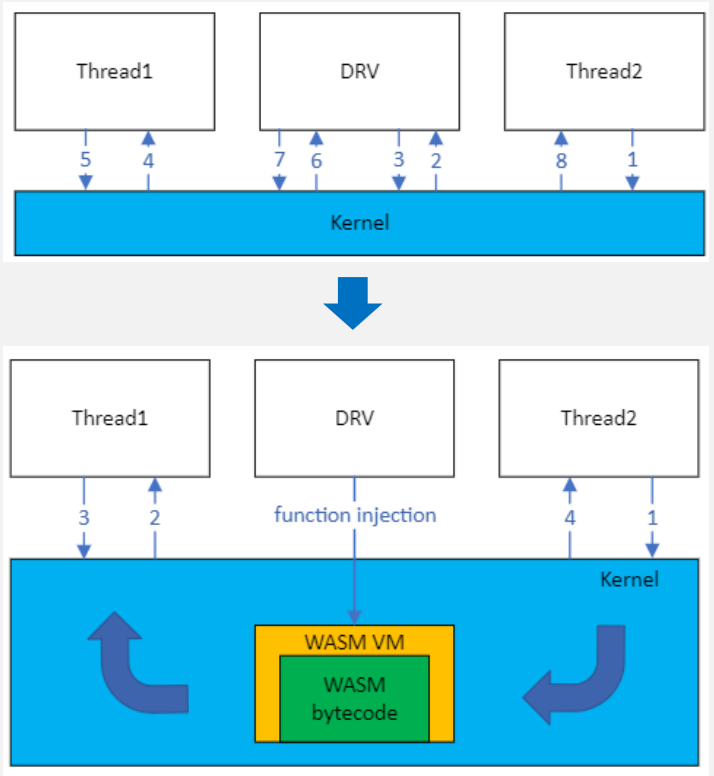
ISR Accelerator

→ Filter interrupt

→ Data pre-process



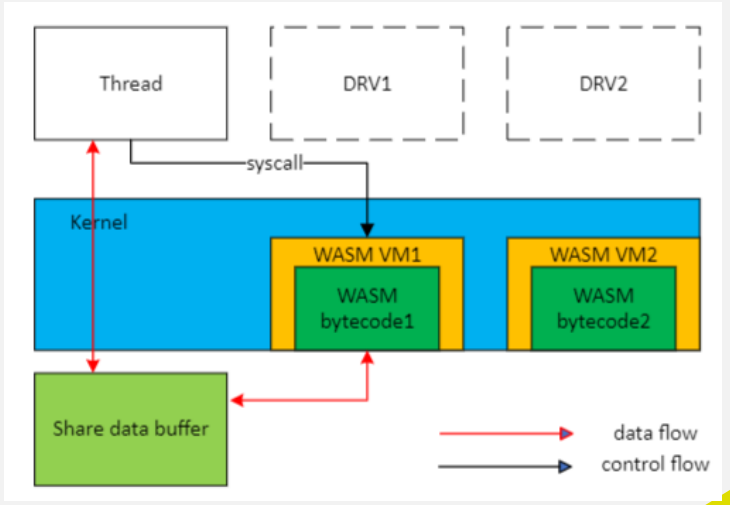
IPC Optimization



Code Injection

→ Kernel test bench

→ Kernel RTE



Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
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Kiitos
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· ĂĕąĿ
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