IPADS
INSTITUTE OF PARALLEL AND DISTRIBUTED SYSTEMS

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Distributed Functionality of OpenHarmony

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(https://dongd.info/)

OpenHarmony is a Distributed OS

- **Observation and vision**
  - People tend to use more and more smart devices

smartphone

smartwatch


pad


mirror


car

…

- **Distributed functionality in OpenHarmony**
  - Connect **multiple smart devices** into **a single super device**
  - Enable apps to utilize remote hardware, remote data, etc.

Distributed OS: Use Cases

- **Use Pad to draw figs**

- **Play games with bigger screen**

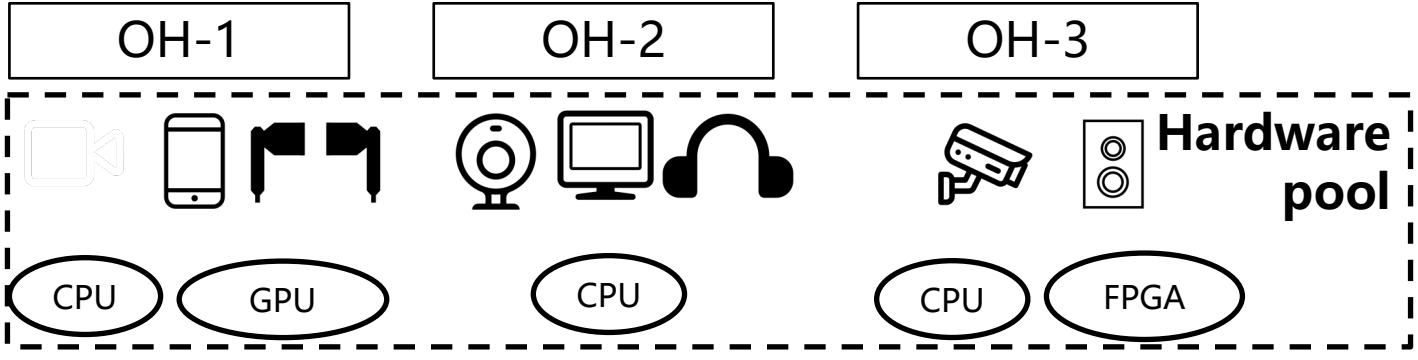
Outline of Distributed OS

- **Distributed hardware/devices**
- **Distributed software bus (D-softbus)**
- **Distributed data**
- **Distributed security**

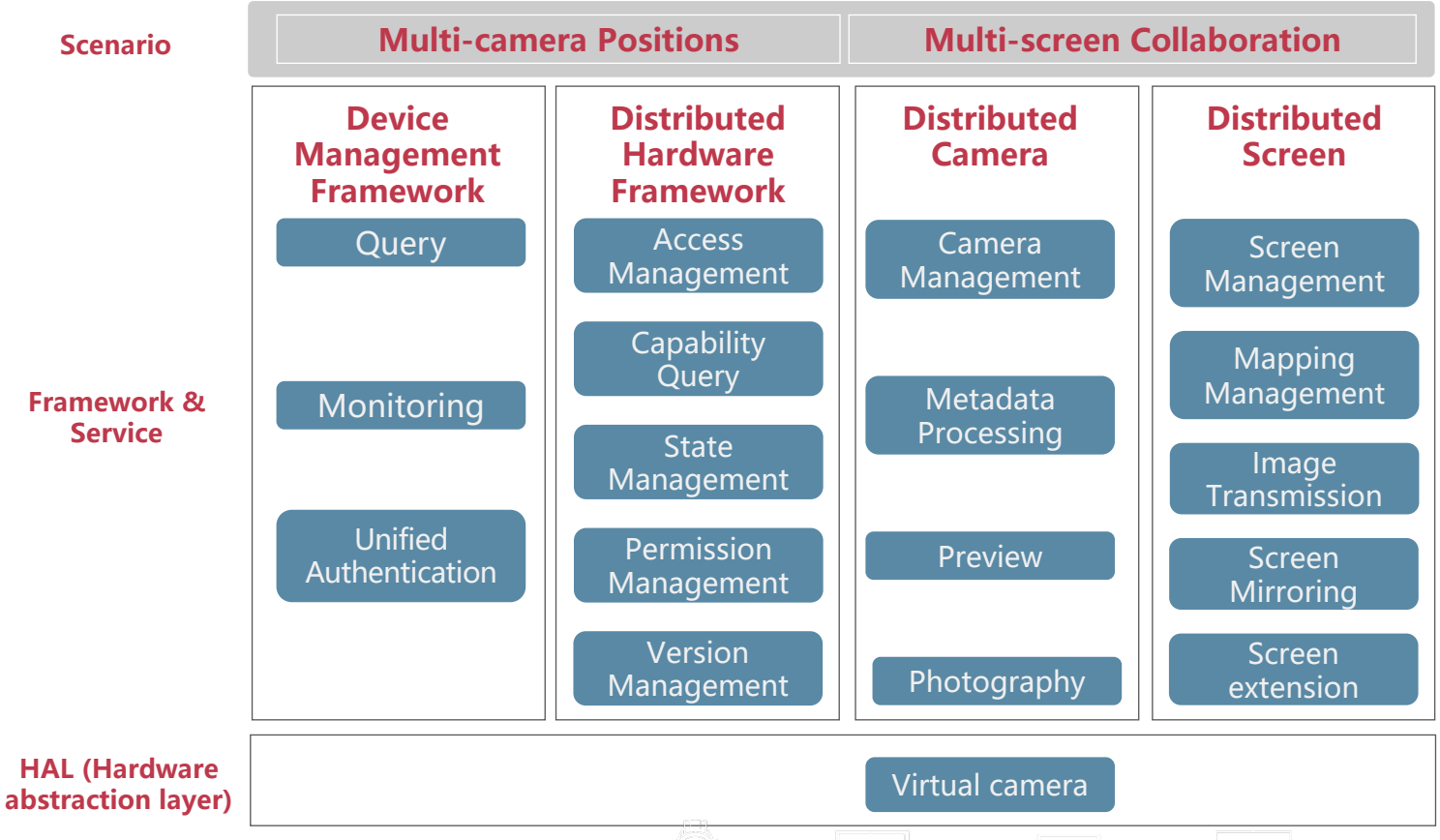
DISTRIBUTED HARDWARE

Distributed Hardware

- **Multiple devices can share their hardware**
  - E.g., one device can directly access remote GPU for computation
- **OpenHarmony provides system supports for distributed hardware**



Distributed Hardware in OpenHarmony



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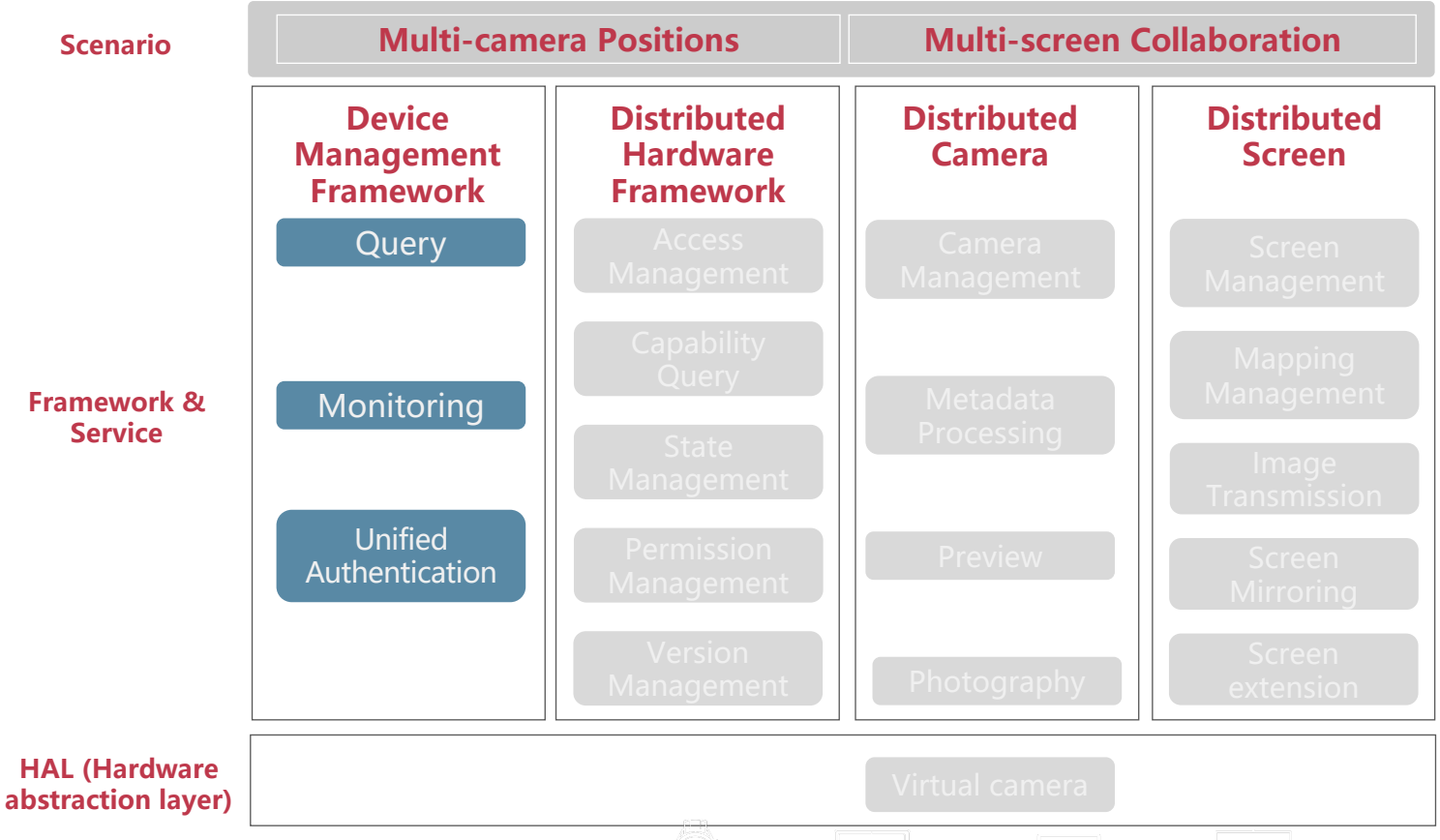
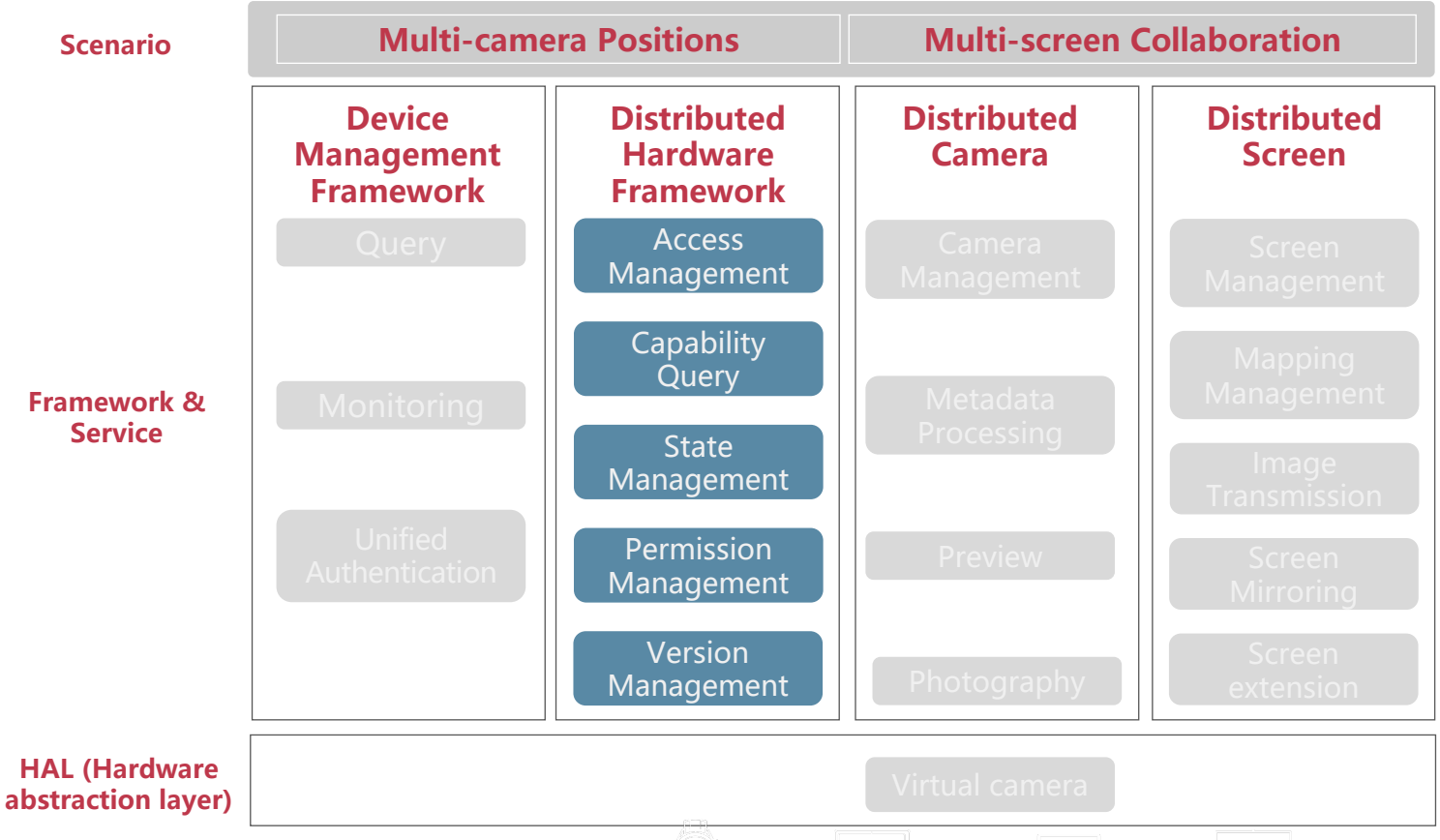


Distributed Hardware in OpenHarmony



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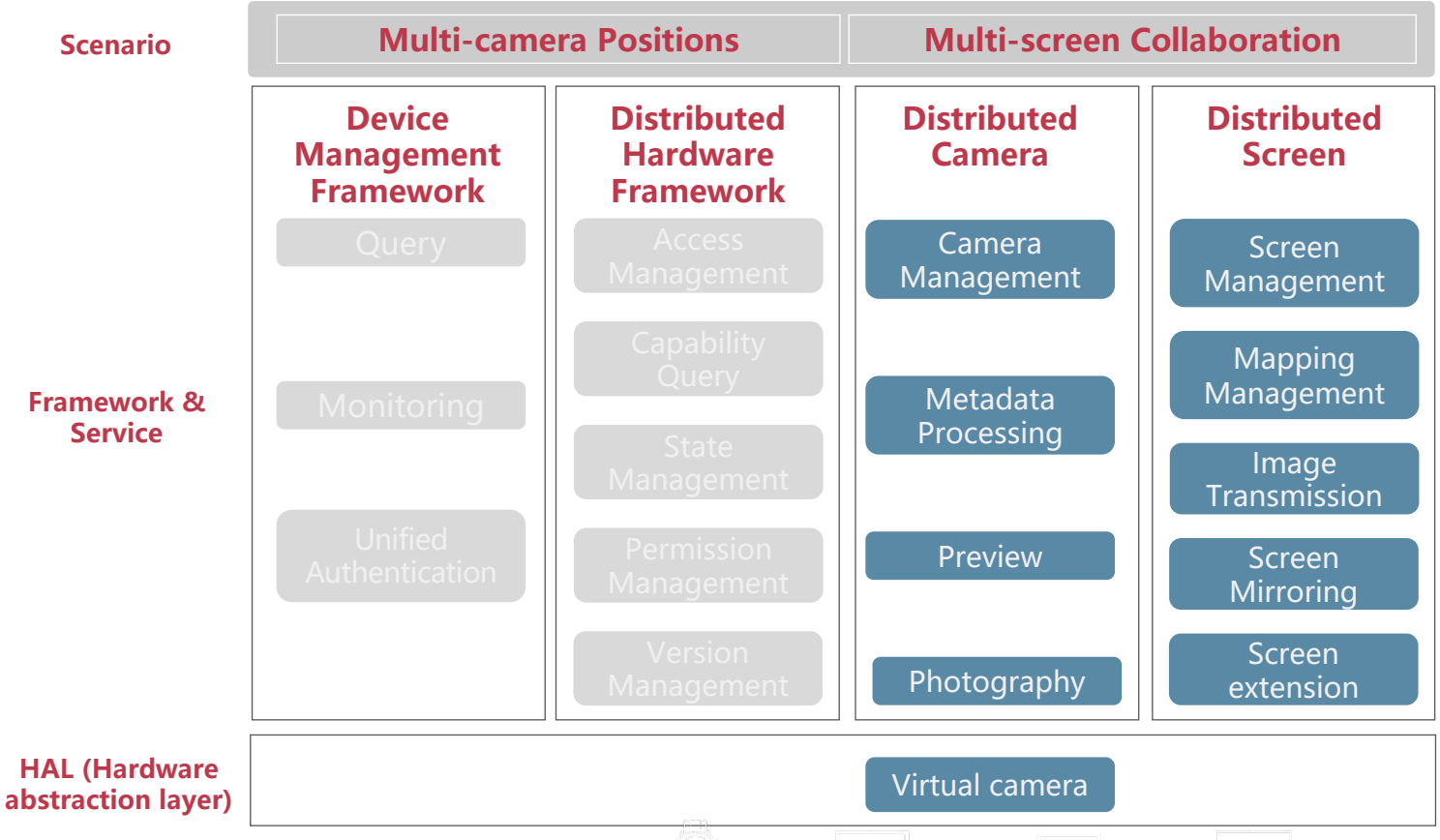
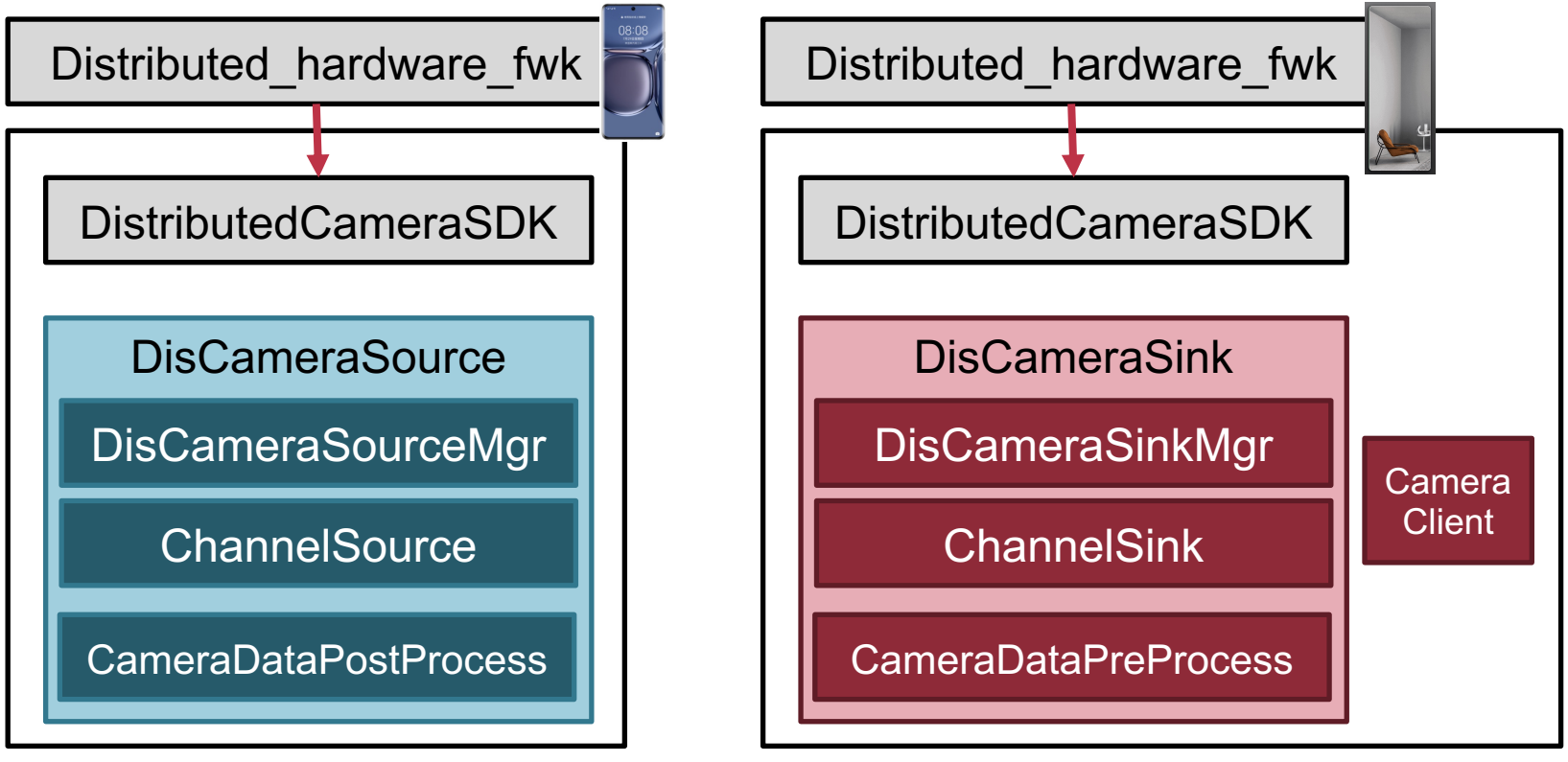


Distributed Hardware: Distributed Camera

Alice

Full-length mirror

Distributed Hardware: Distributed Camera



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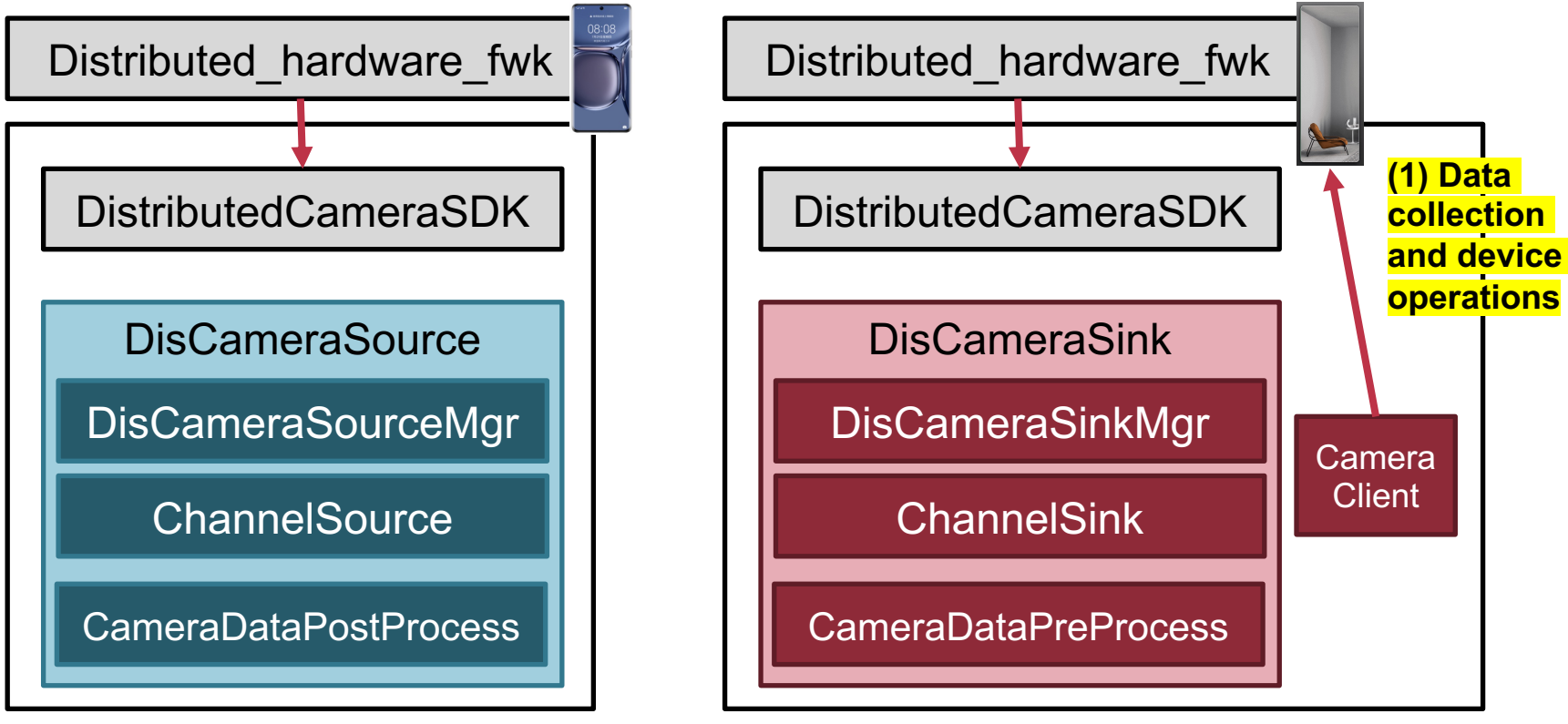

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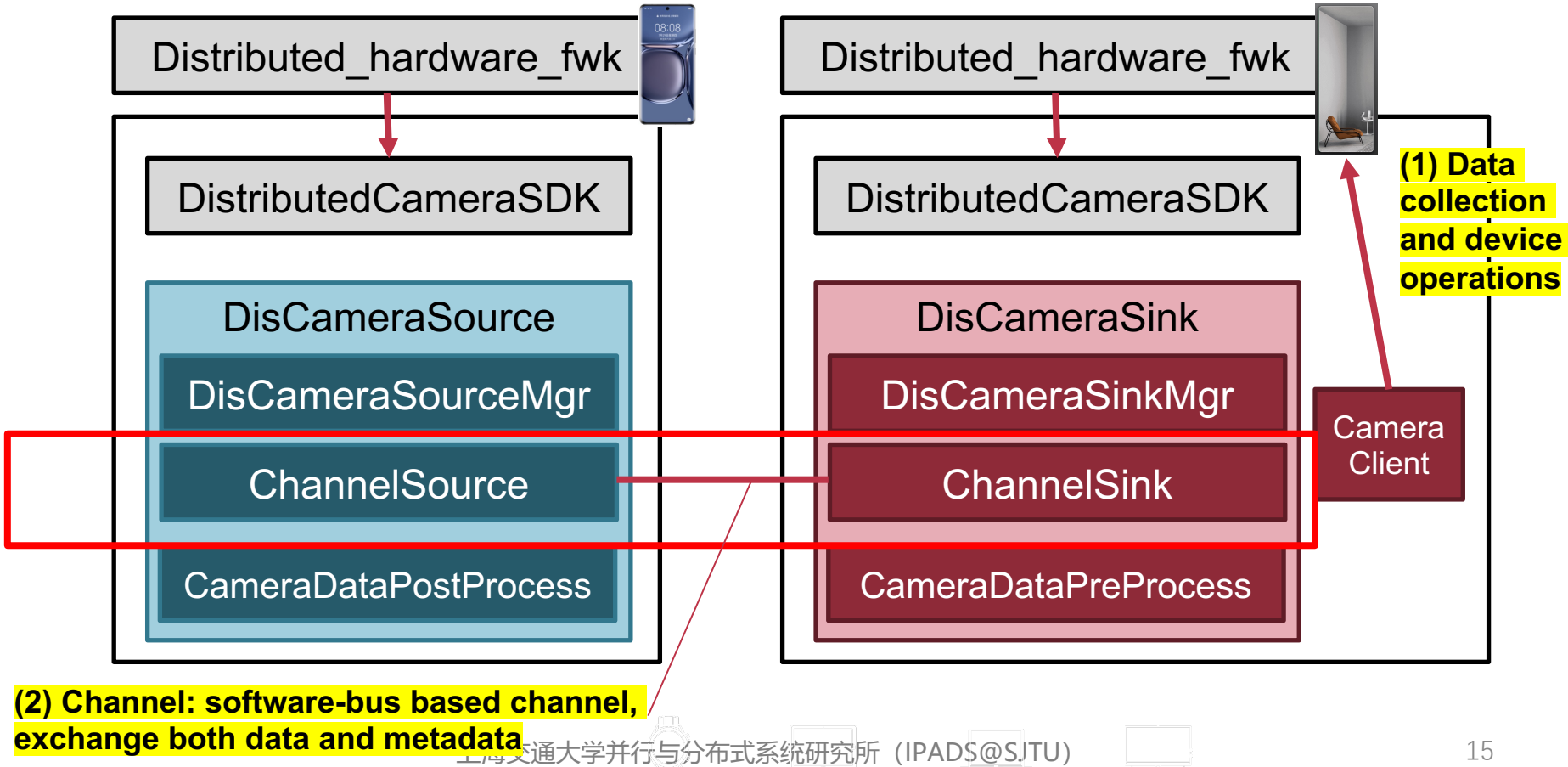

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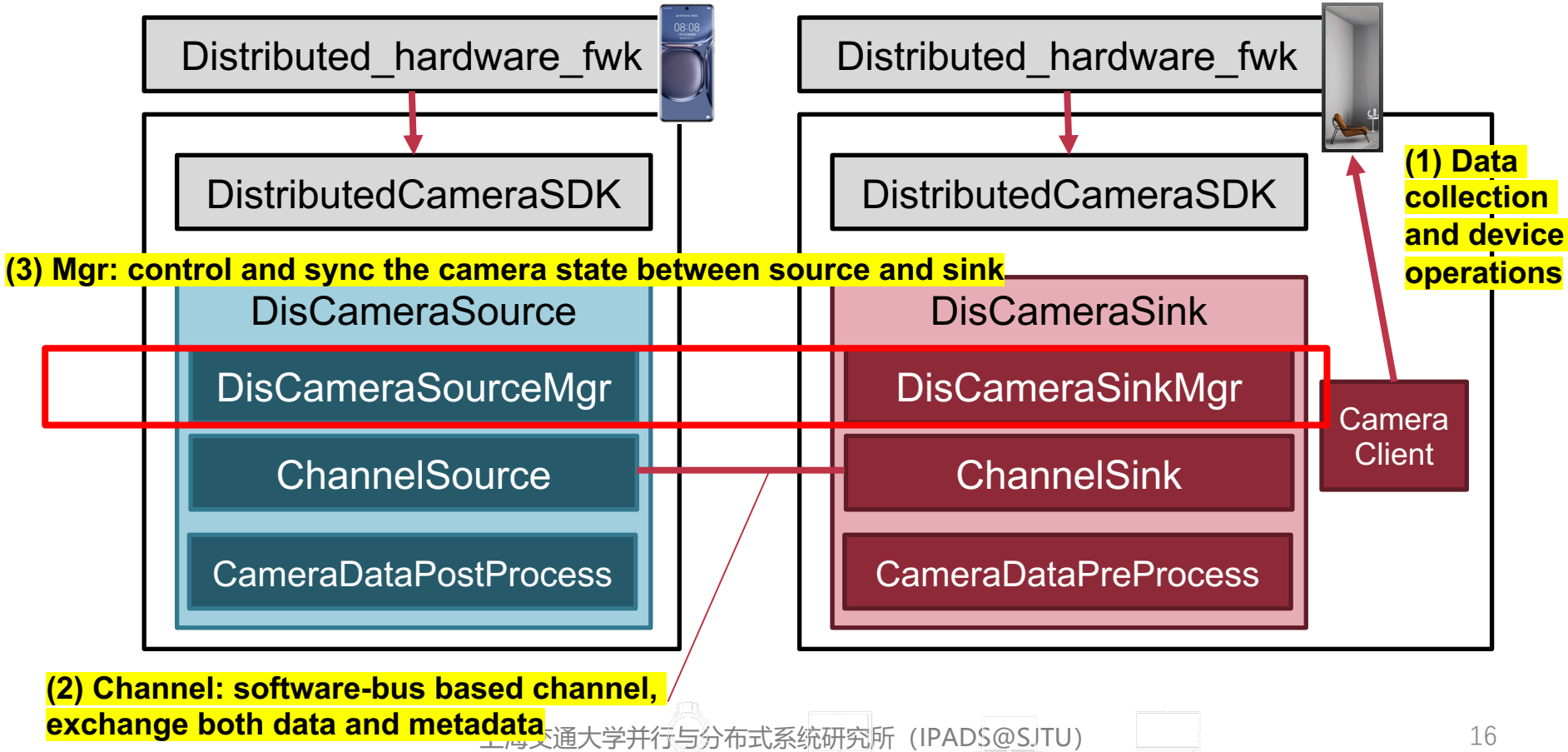

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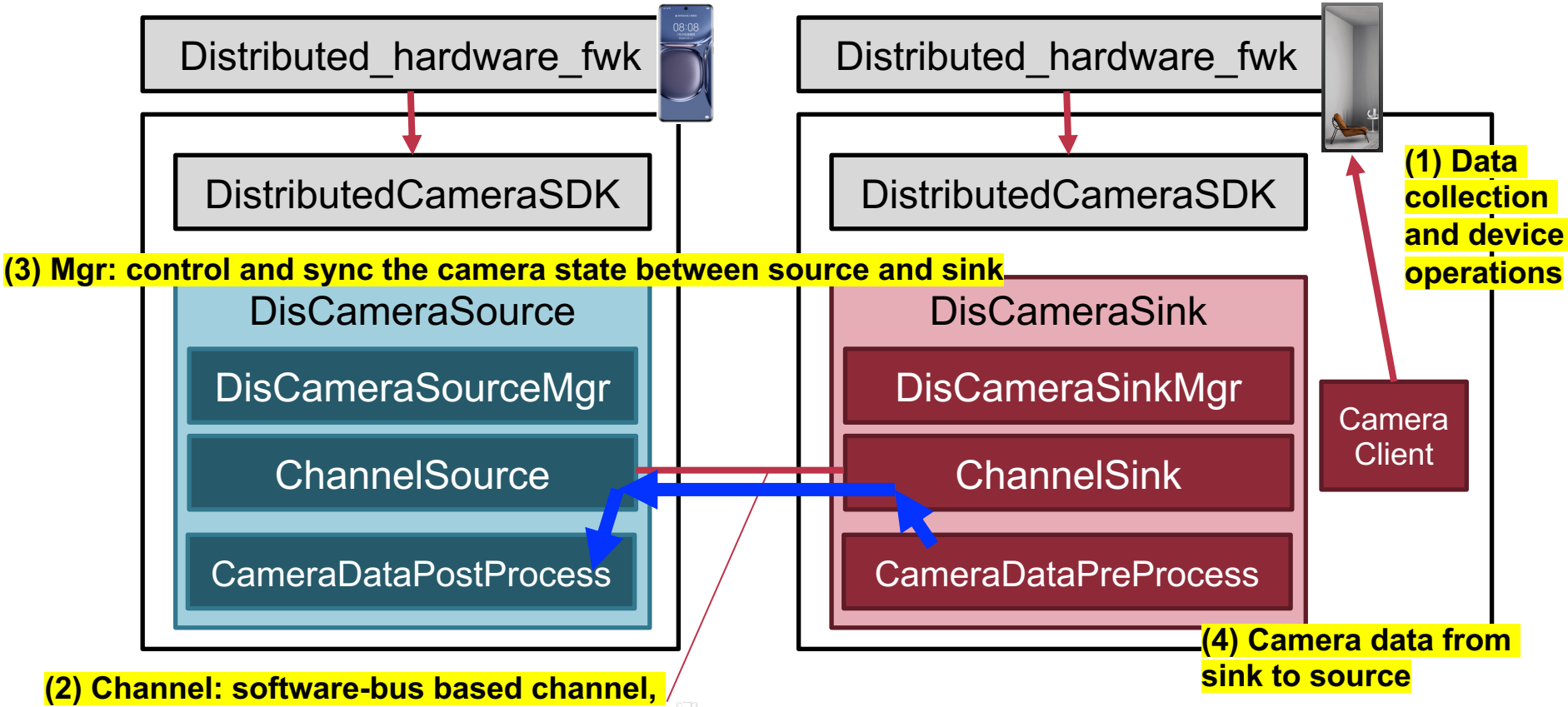

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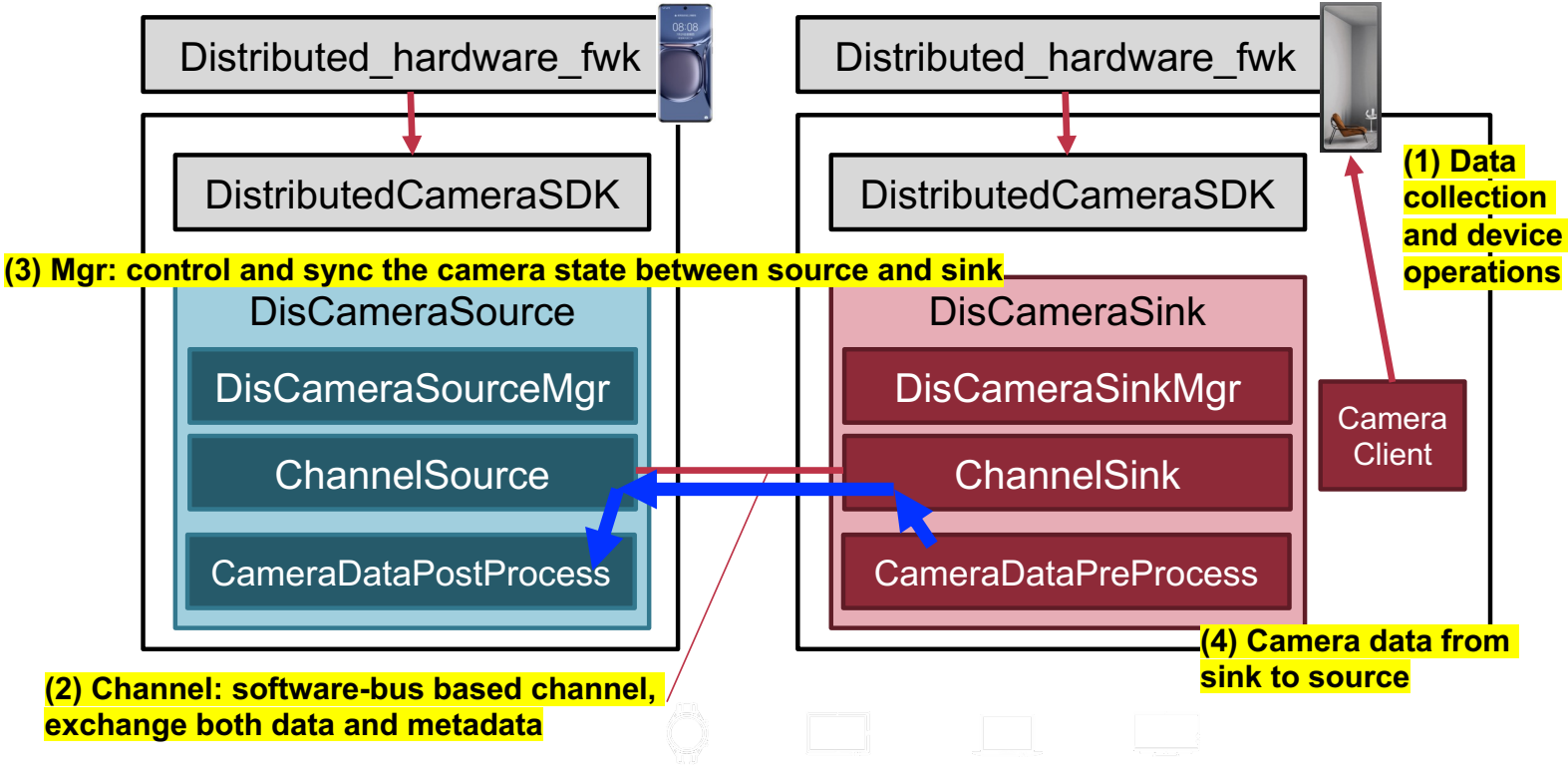

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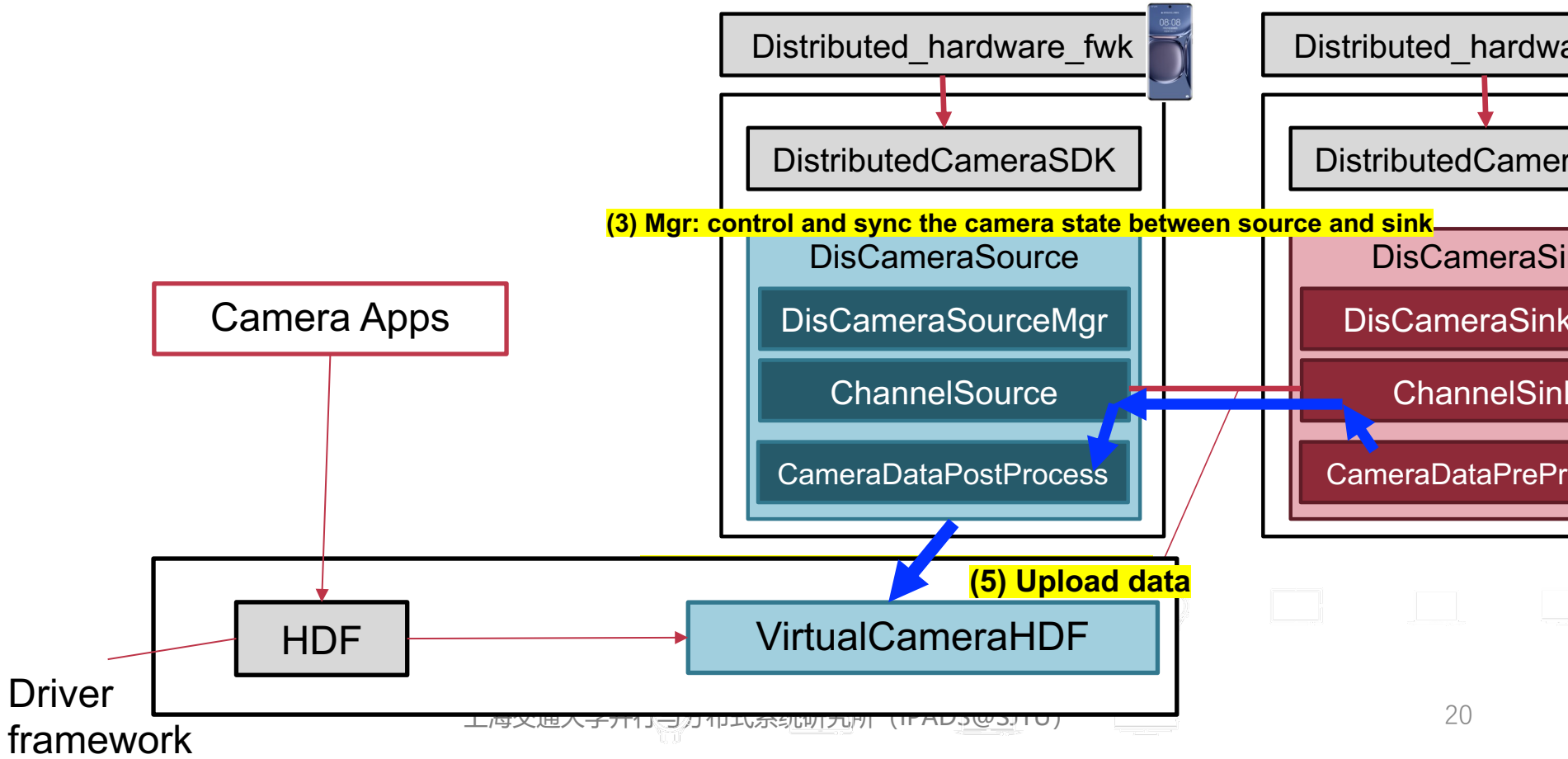
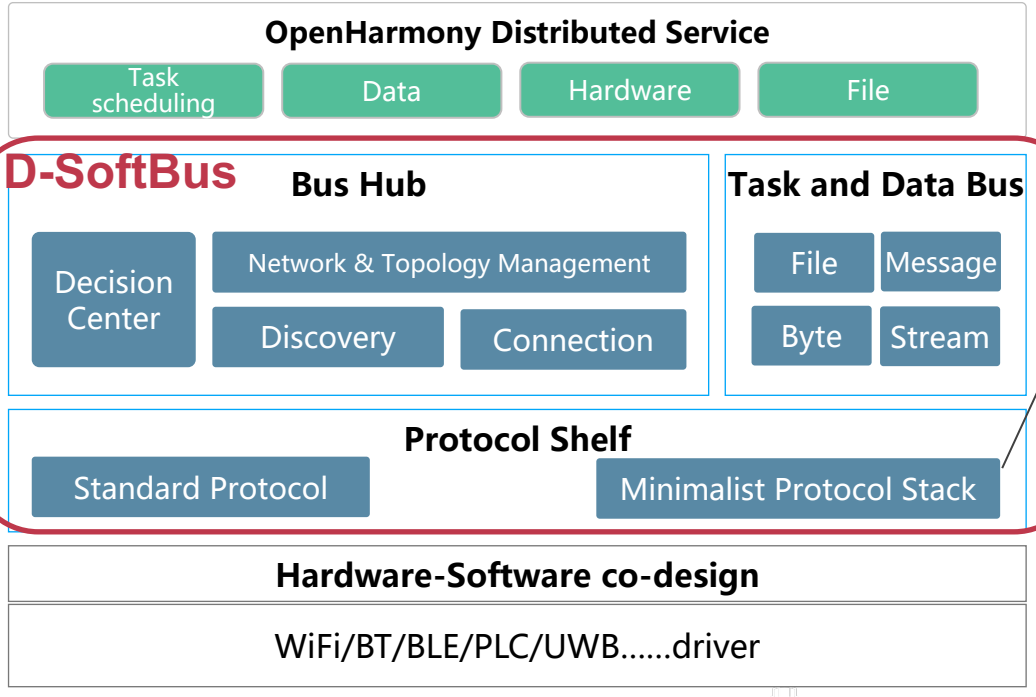
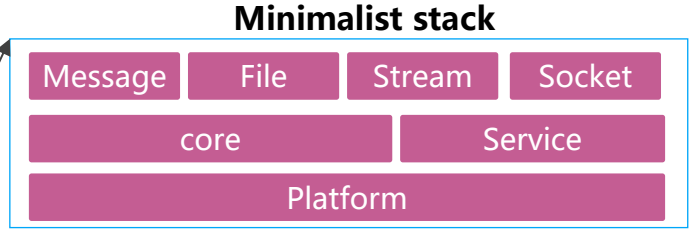


DISTRIBUTED SOFT-BUS

Distributed Soft-Bus

Distributed Soft Bus for **discovery**, **connection**, and **data transfer**, providing a real-time online connectivity channel for mobiles/IoT





Eliminates **redundant header overhead**, leverages real-time MAC layer status to accurately sense **wireless network quality**, and adjusts packet transmission rate precisely

- **Compressed protocol layers**
- **Precision Congestion Control**
- **Chip Frequency Tuning/Energy Saving**

D-SoftBus: Device Discovery

- **Phone**
  - Using specific protocol to broadcast the discovery request

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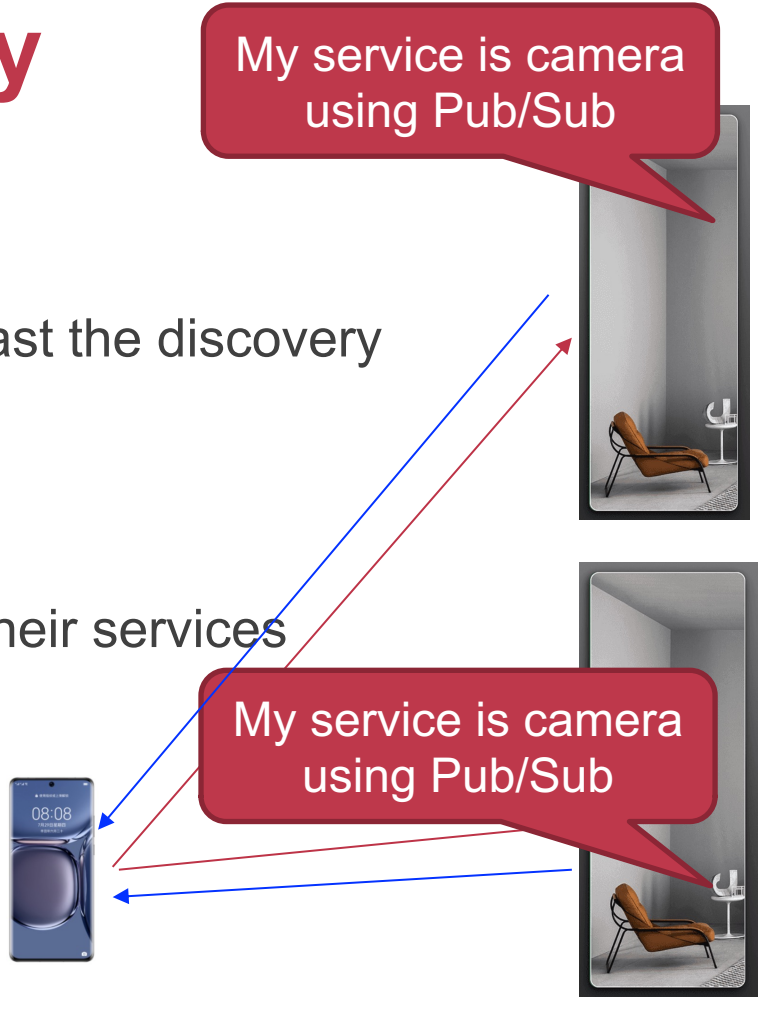
- **Devices**
  - Using pub/sub model to expose their services
  - Ack the requests



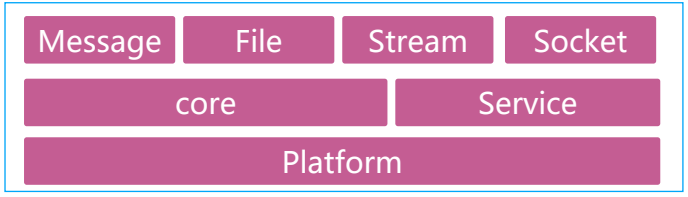
D-SoftBus: Discovery

- **Phone**
  - Using specific protocol to broadcast the discovery request
  - Update the D-SoftBus info
- **Devices**
  - Using pub/sub model to expose their services
  - Ack the requests

D-SoftBus: Transmission

- **Customized protocol**
  - Minimalist network stack
  - Other customizable (e.g., QUIC)
- **Multi-Path transport**
  - Utilize abilities of 4G/5G/WLAN/etc.
- **Intelligent latency control**
  - Optimize latency
- **Dynamic resource scheduling**

Minimalist stack



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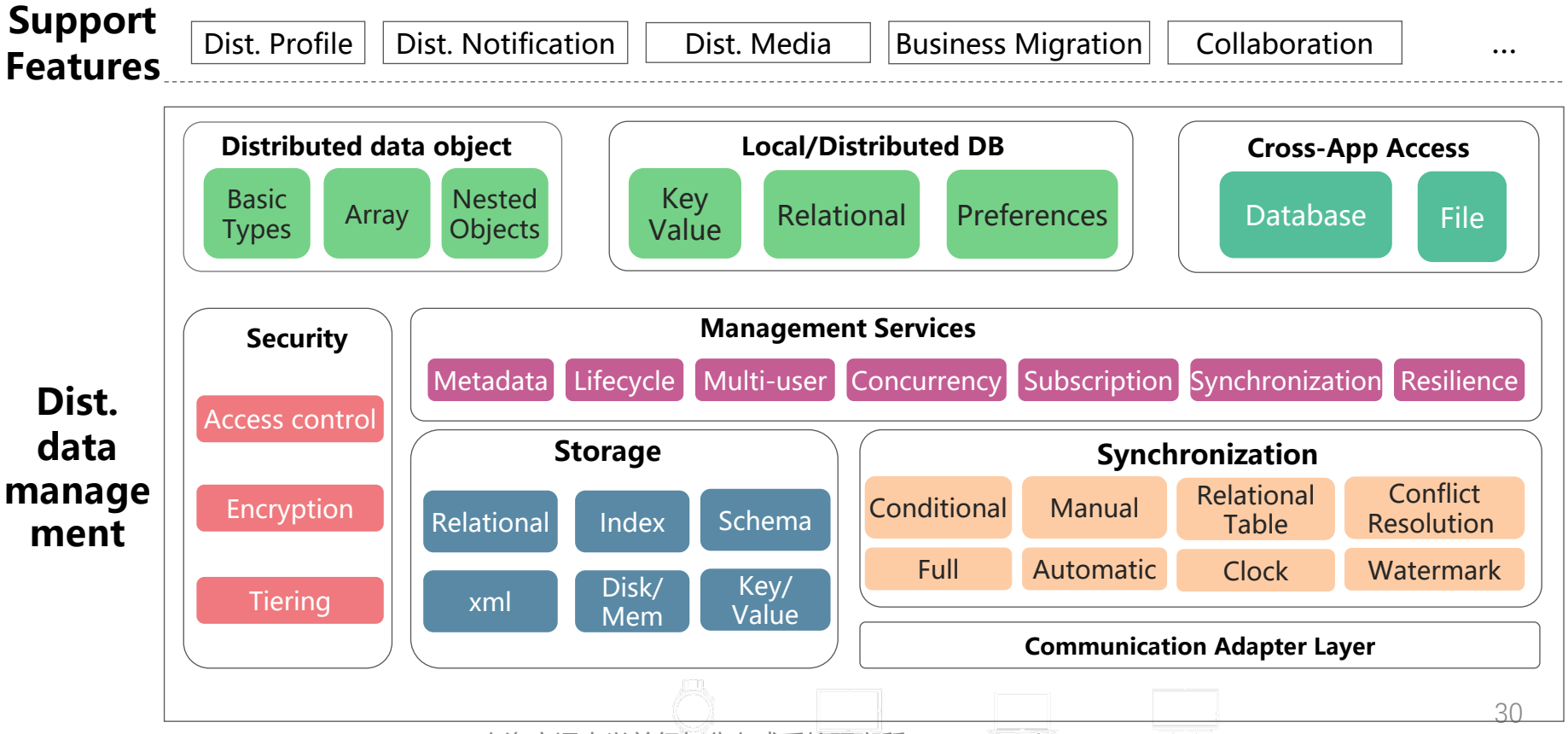
DISTRIBUTED DATA

Distributed Data

- Different apps on the same device can share data
- Different apps on different devices can share data
- The same apps on different devices can share data

- Also provides management, reliability, and security related functionalities

Distributed Data



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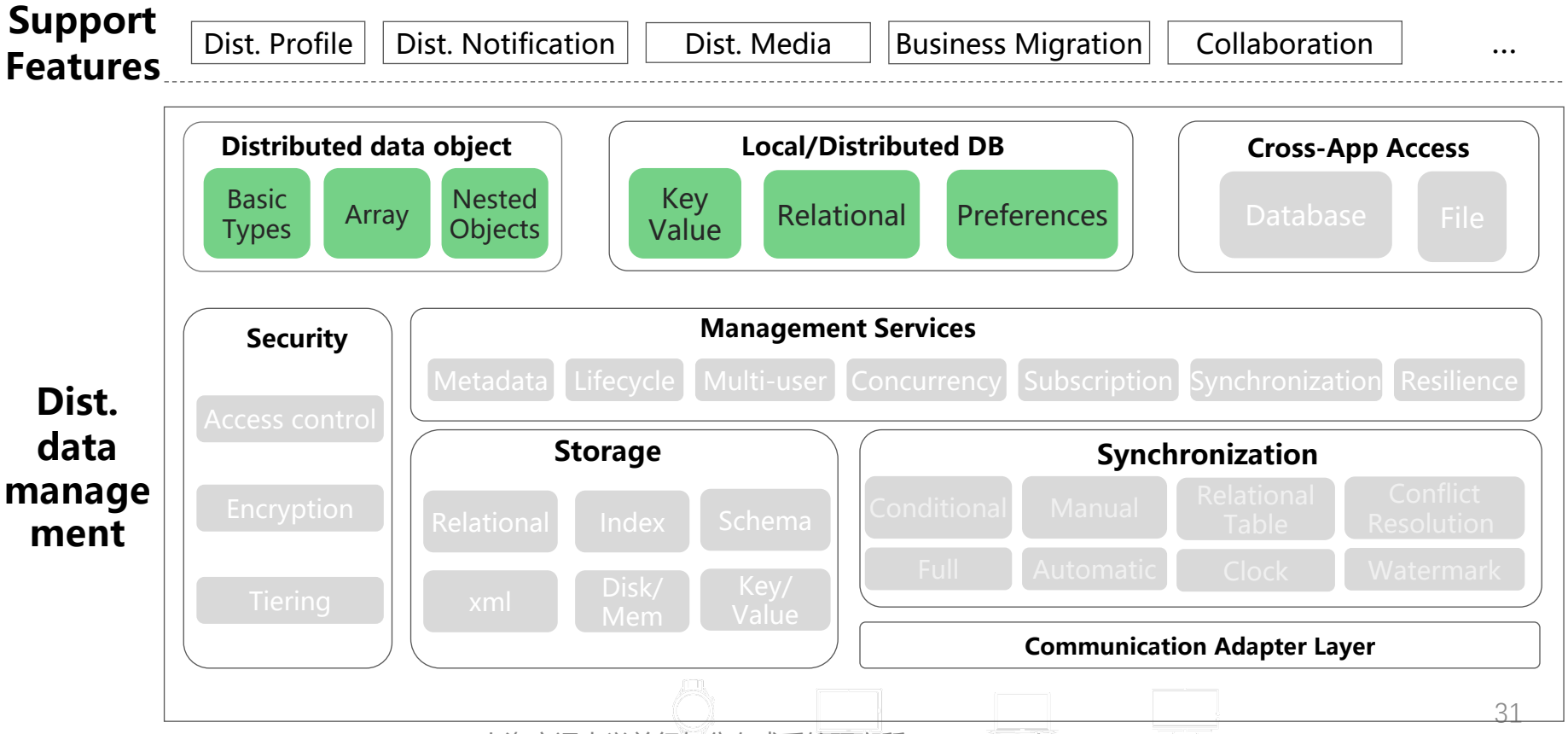

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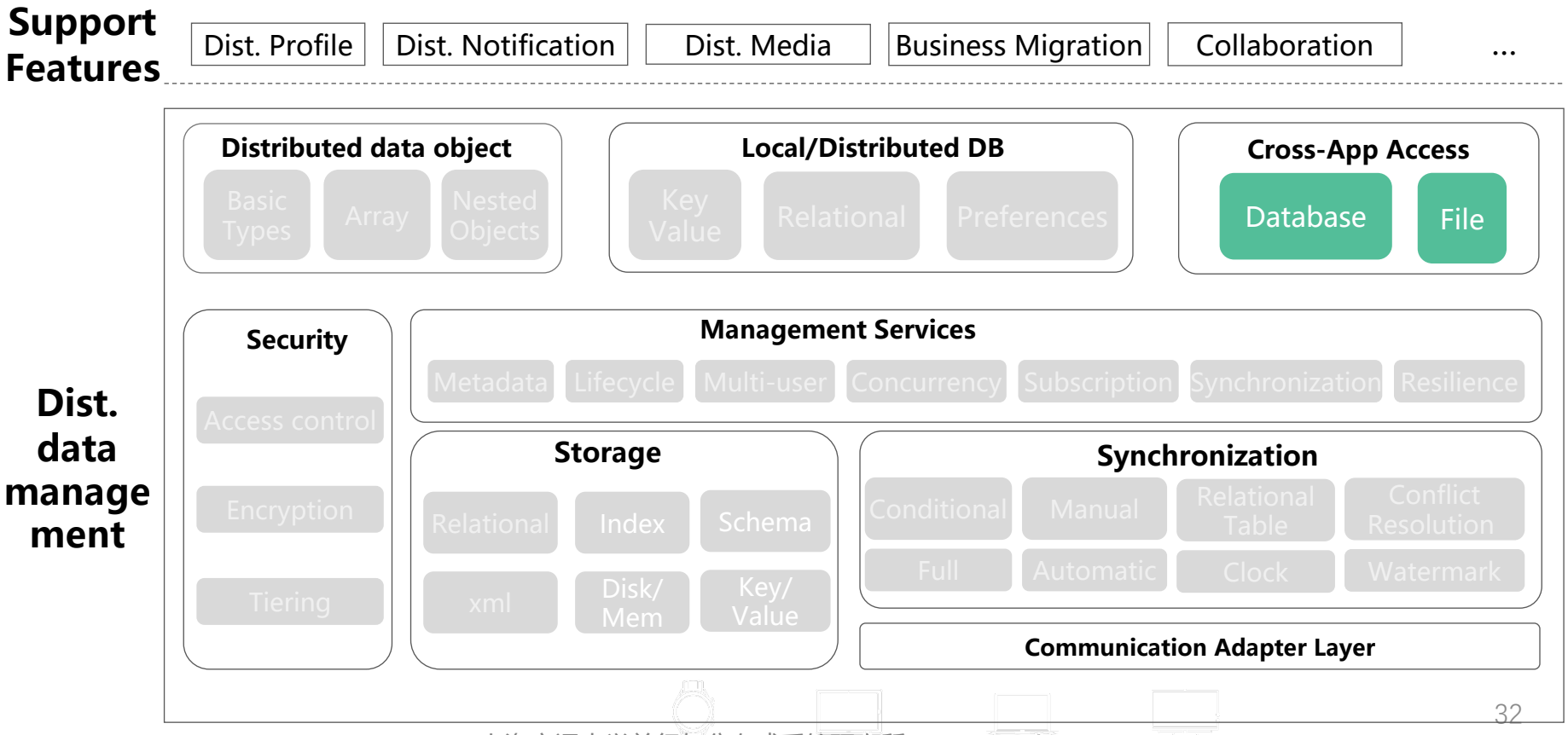

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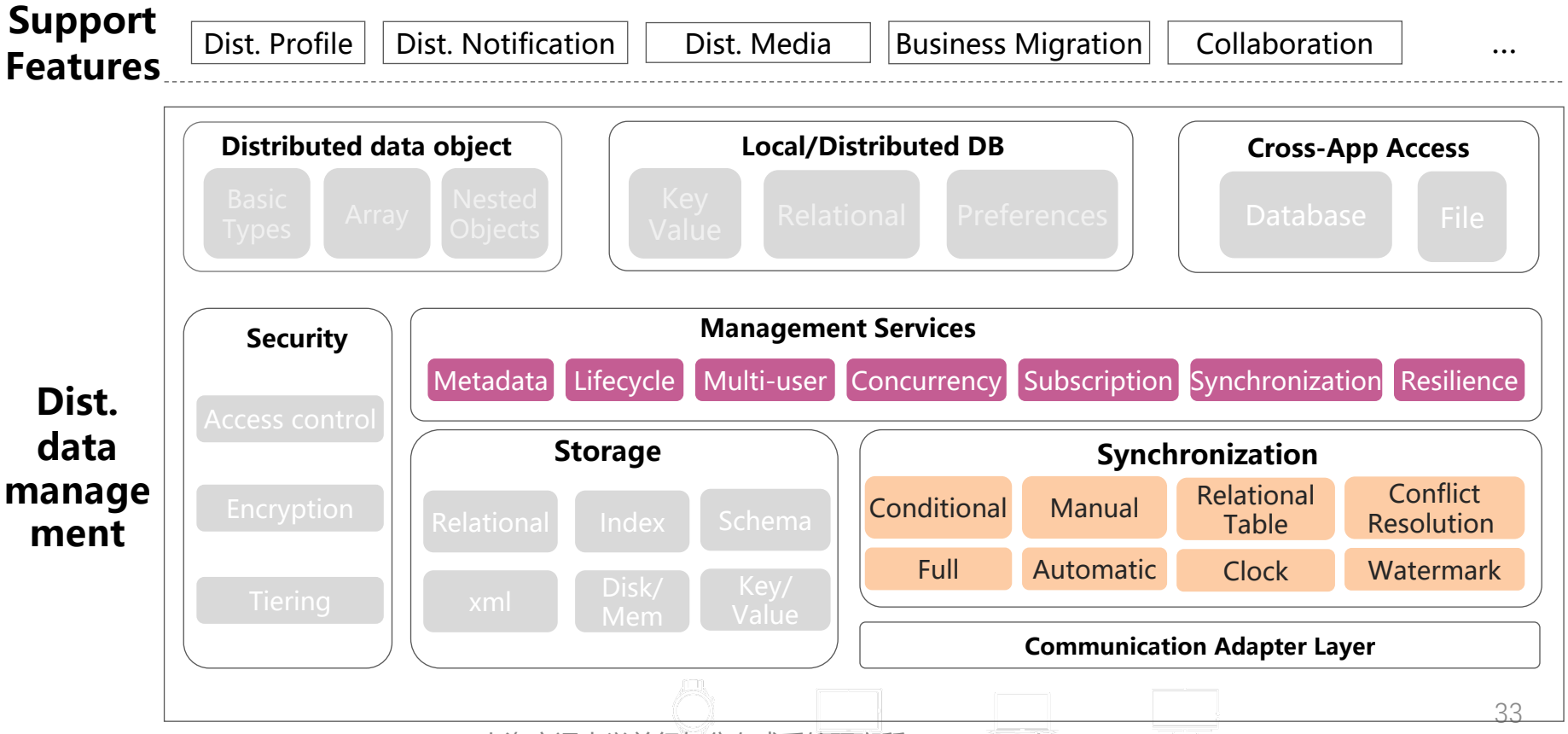

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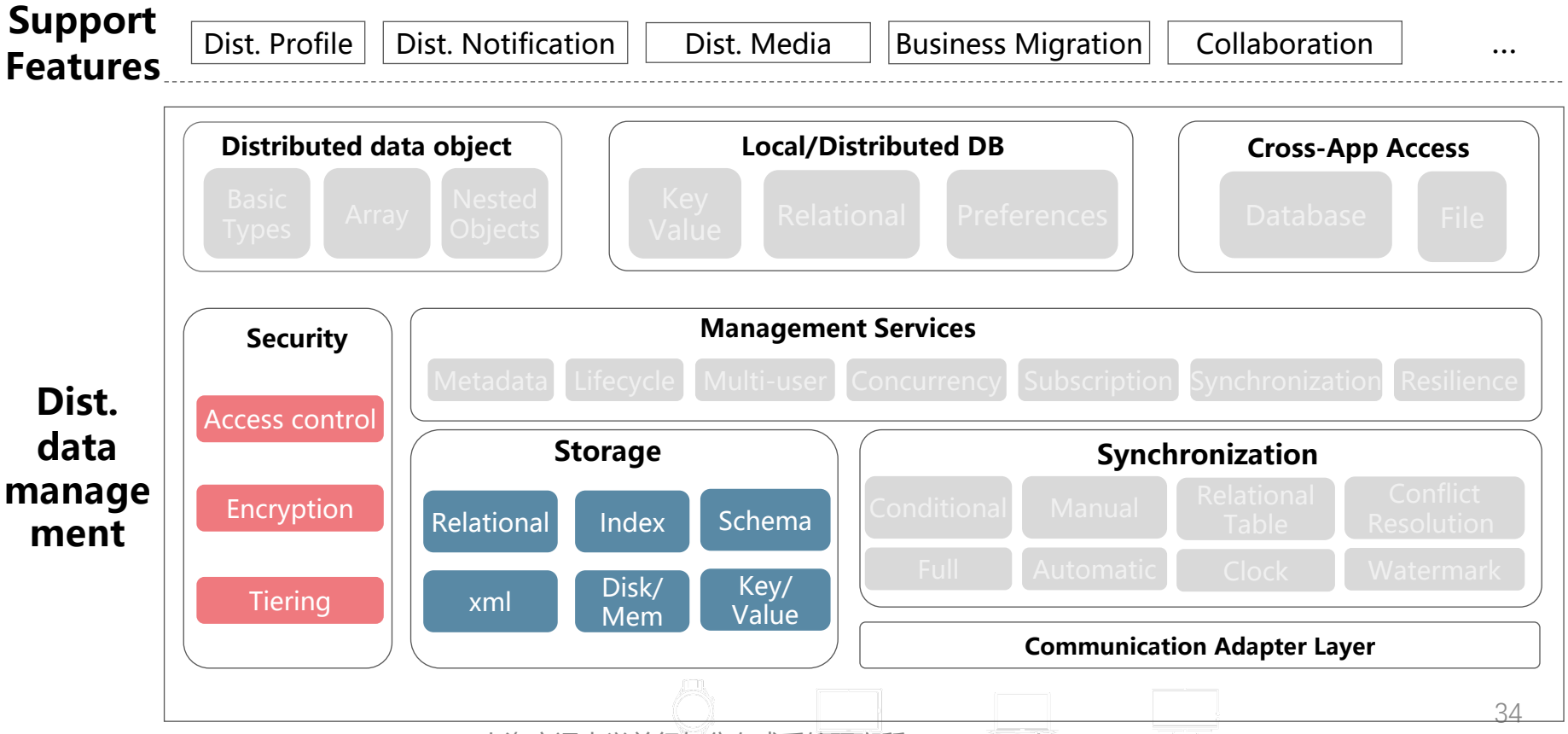
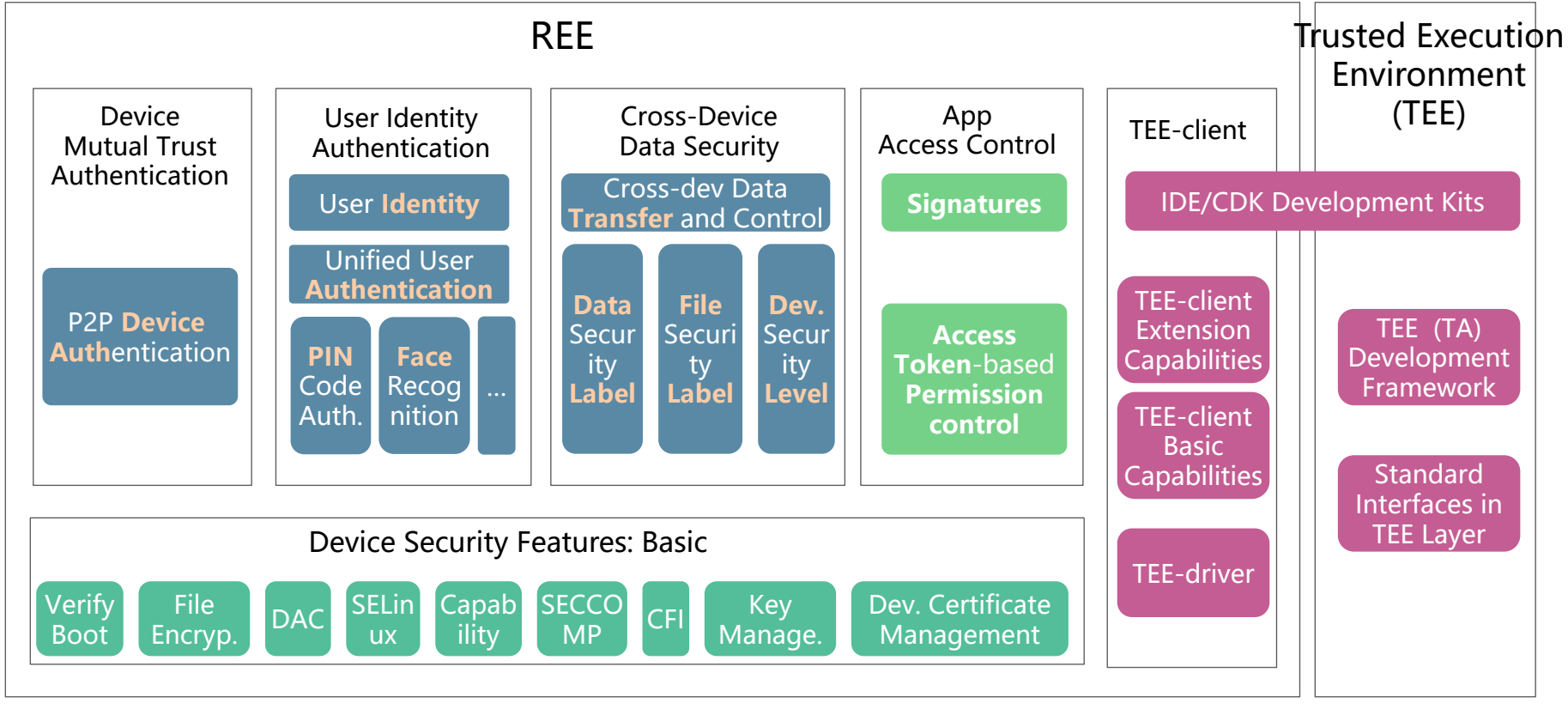


DISTRIBUTED SECURITY

Security: From Single to Distributed OS

- **Multi-device network and the authentication**
- **Access control is basic for a single OS, how it works for multi-dev and multi-OS**
- **Trusted execution environment (TEE)**

Distributed Security Framework



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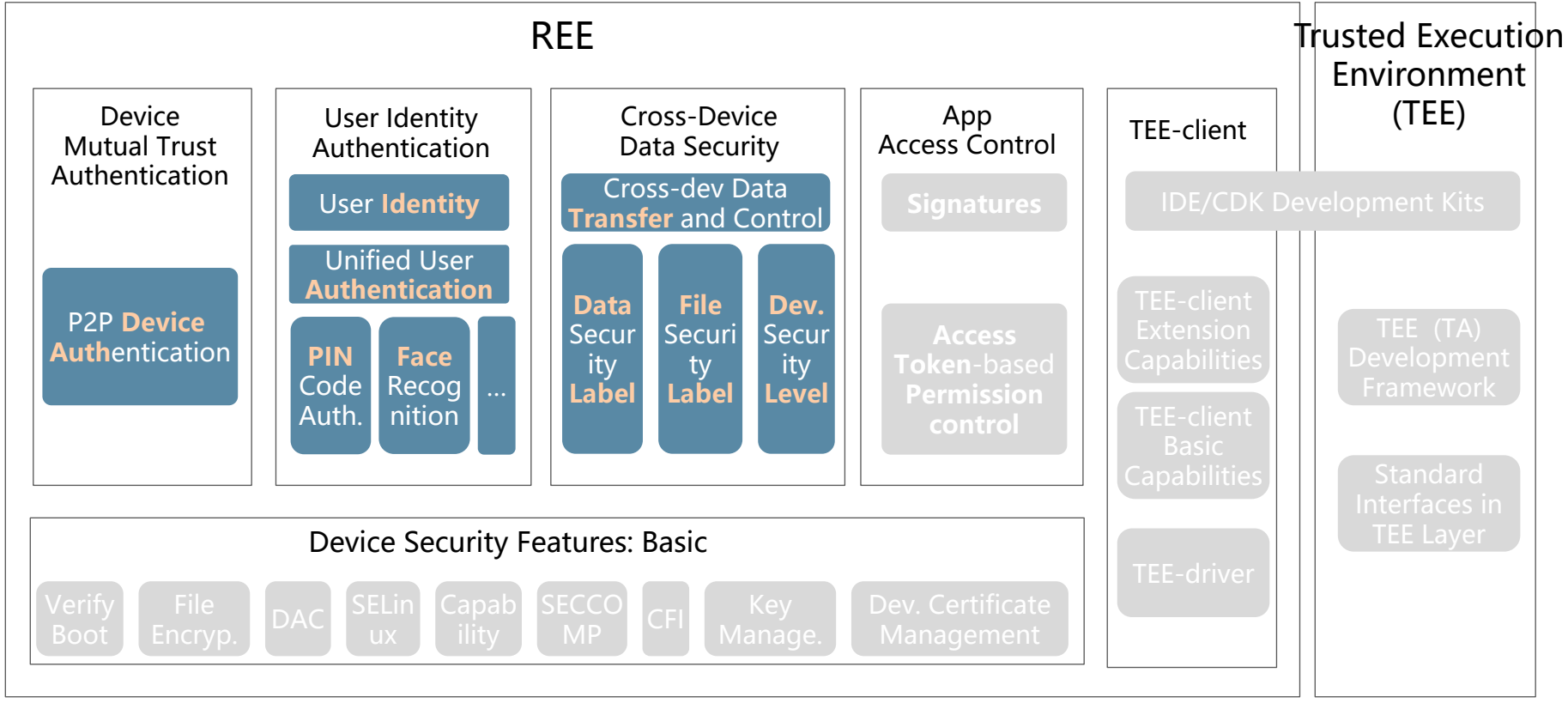

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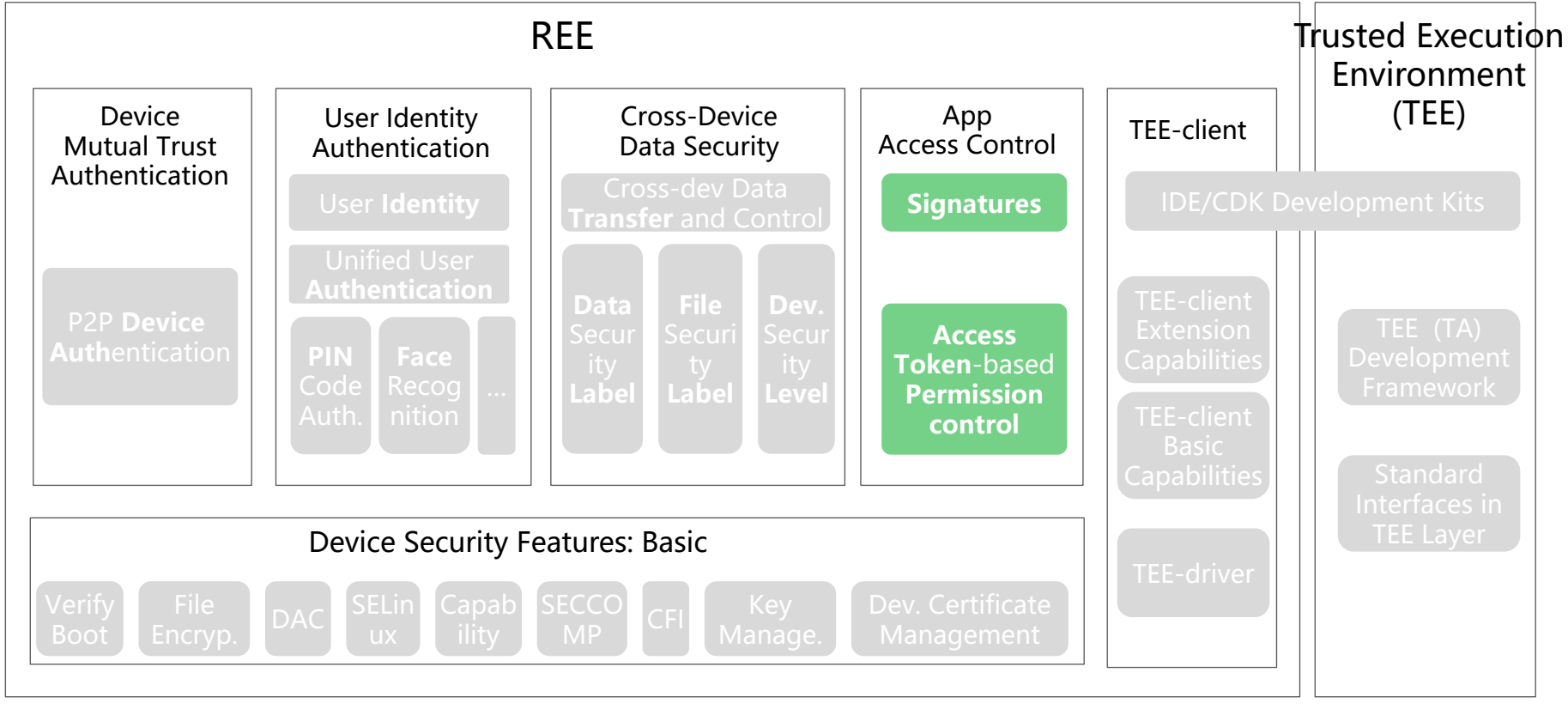

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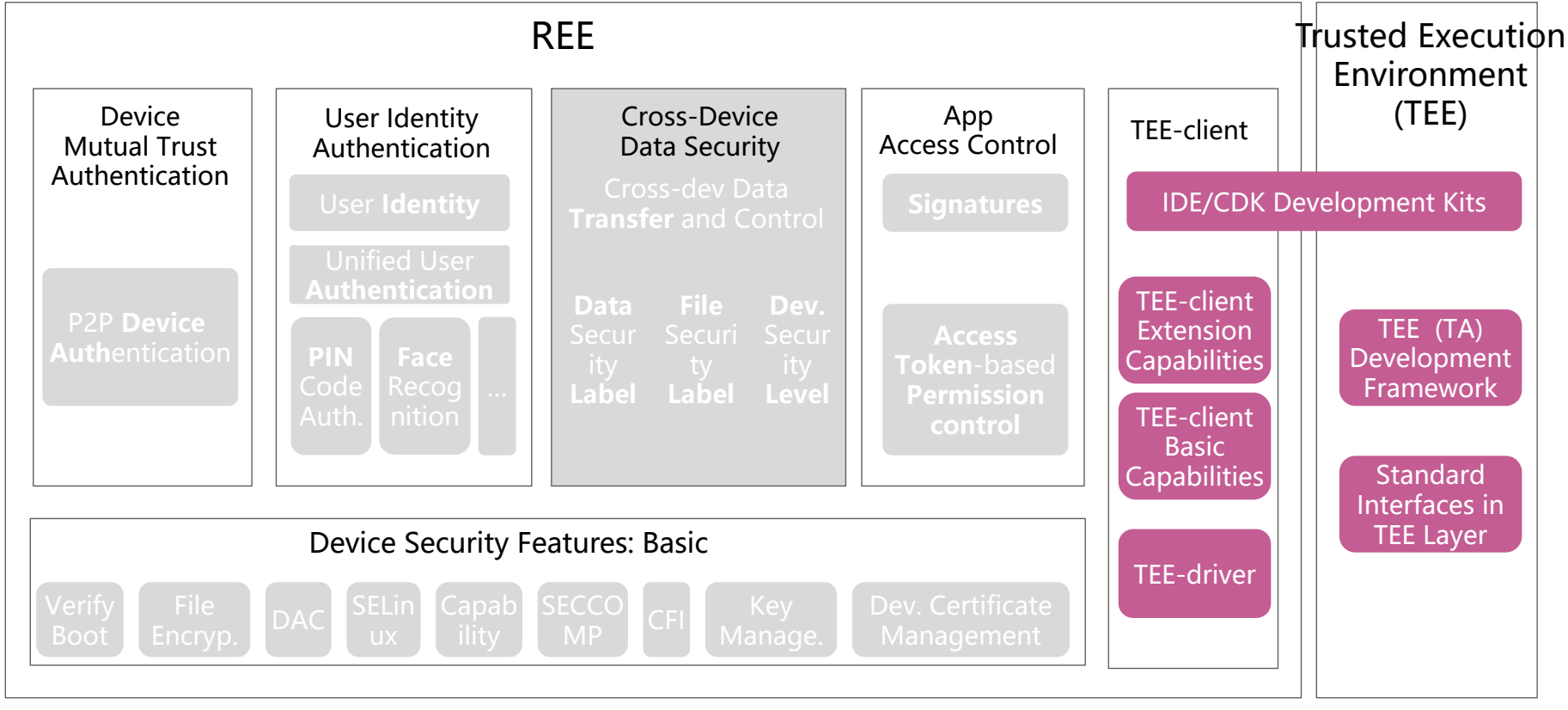

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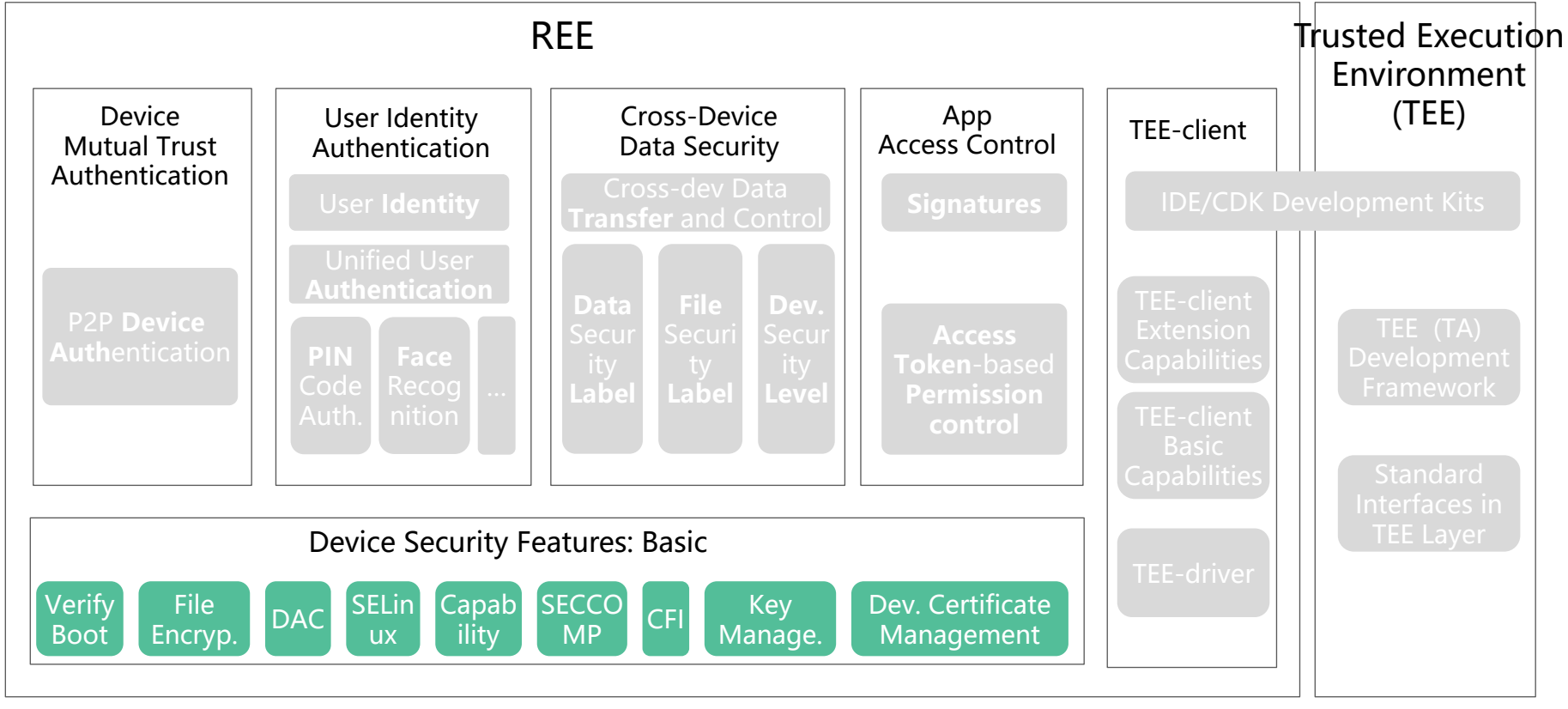

Summary

Feel free to contact me: dd_nirvana@sjtu.edu.cn

- **OpenHarmony takes distribution as the first-class capability**
  - Distributed hardware
  - Software bus
  - Distributed data
  - Distributed security
- **Try the exercise/demo in following talk/sessions ☺**
  - How to build and run **distributed apps** that can migrate from two devices and share data
  - **Vsync** Demo (**ASPLOS'21 distinguished paper**)
  - In the last demo, we will show how **TEE is distributed**