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Investigation of High-Efficient Transfer Mechanisms for SCA 4.1

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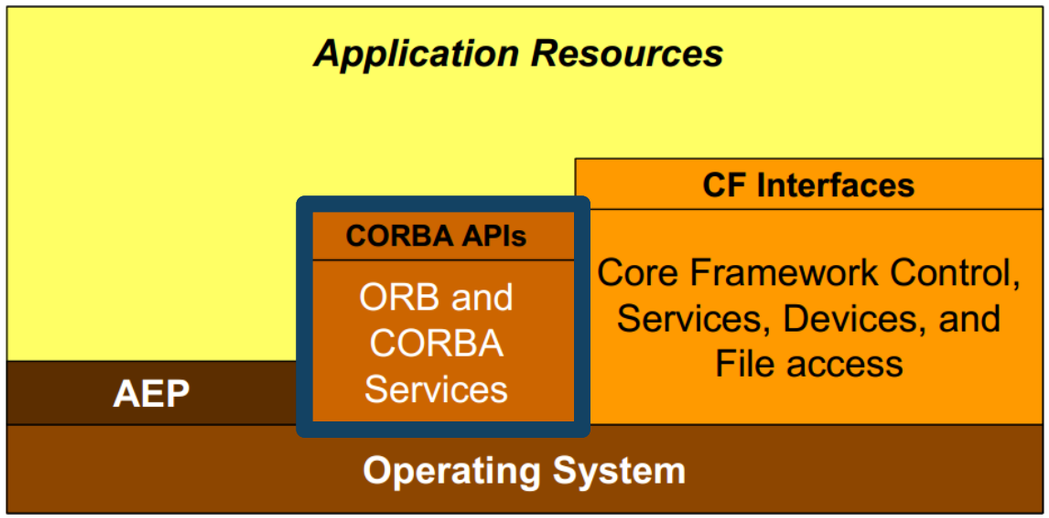
Outline

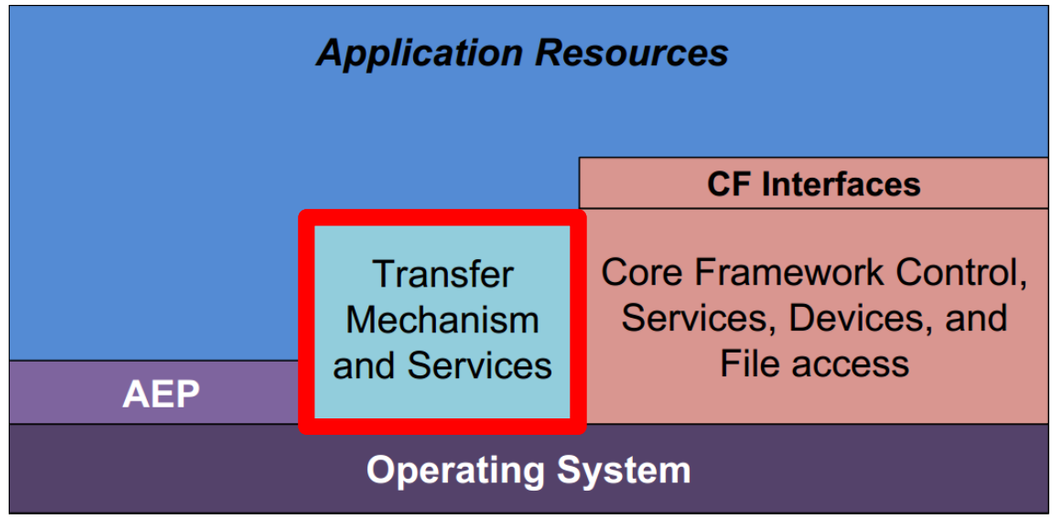
- Introduction
- Implementation of transfer mechanisms
- Efficiency comparison
- KD-RPC
- Conclusion

Introduction

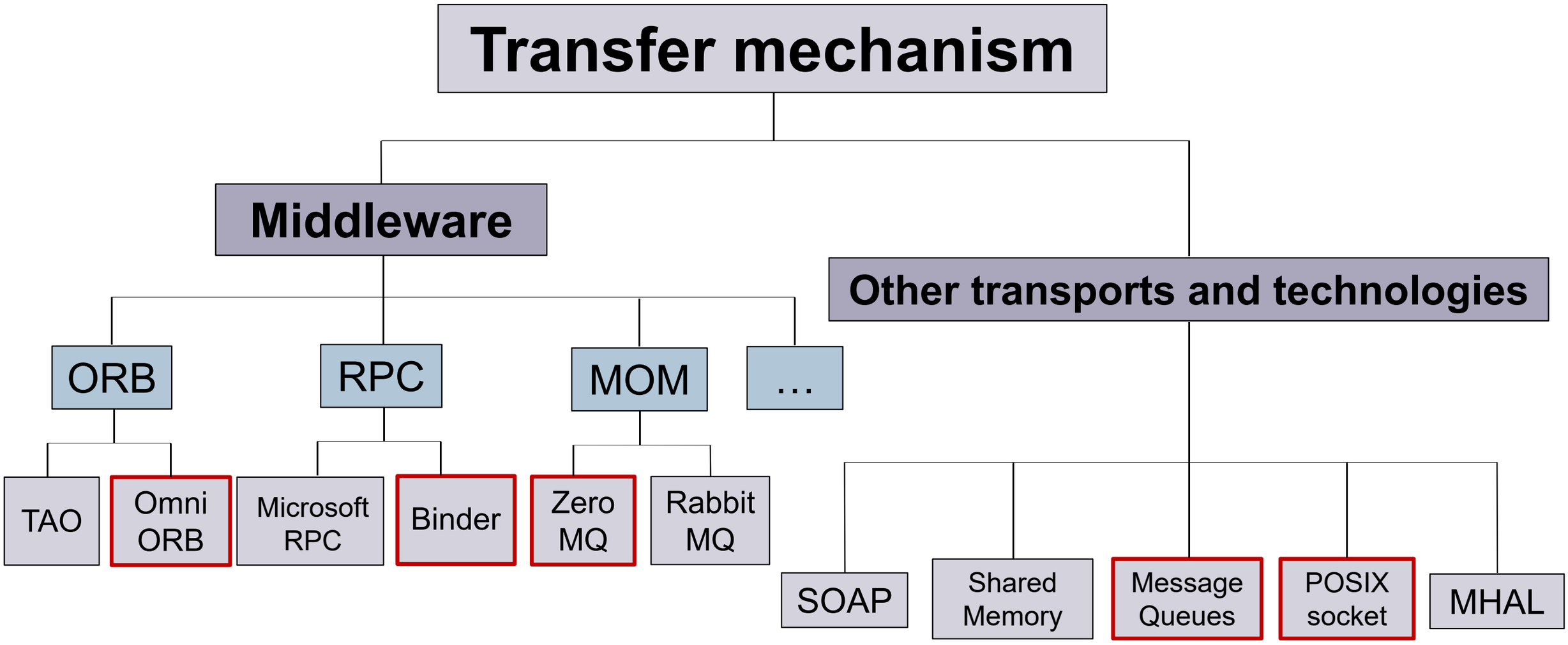
SCA 2.2.2



SCA 4.1



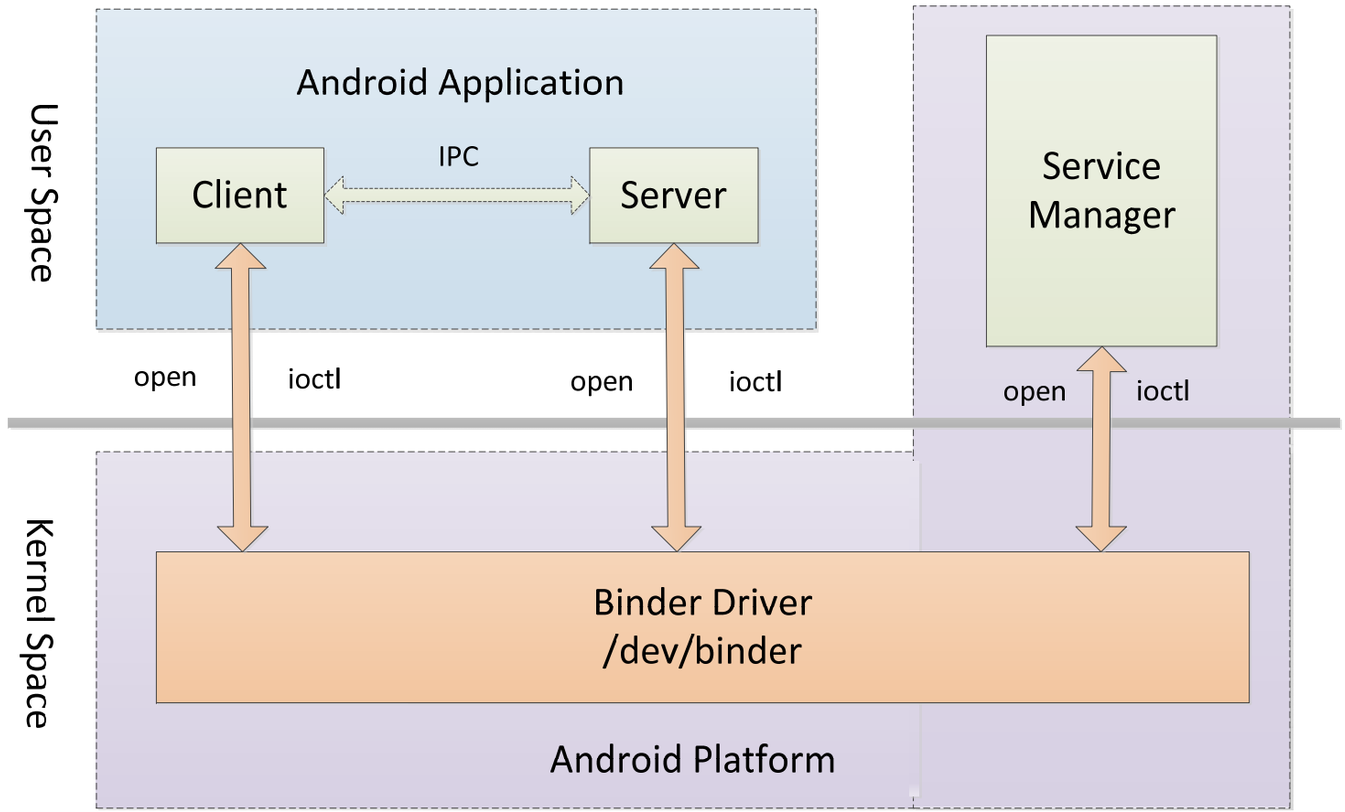
Introduction



Implementation of Binder

Binder — RPC in Android platform.

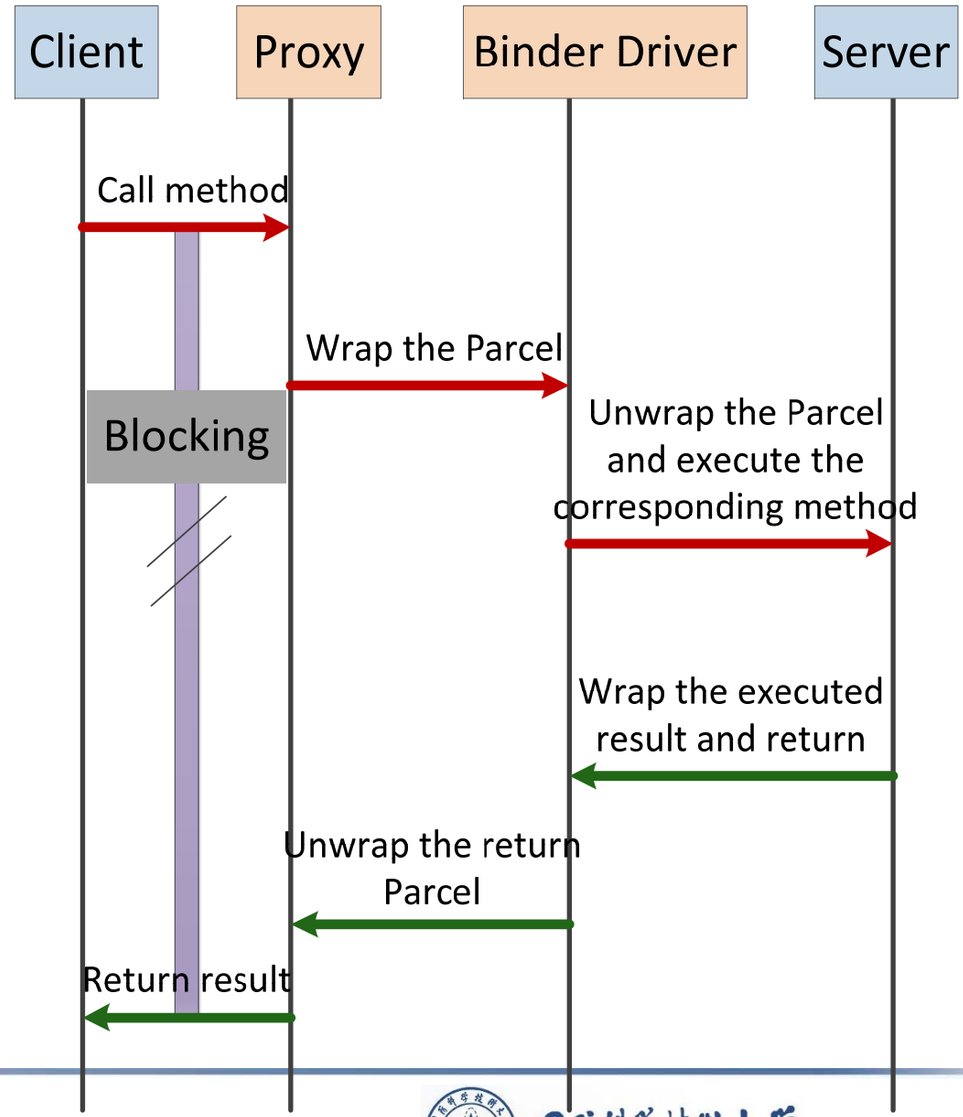
- One-time copy technique
- Credible identity verification
- Centralized system only



Implementation of Binder

Synchronous communication

- **Step 1**: Client obtains the interface of Server from Proxy;
- **Step 2**: Proxy wraps the method and parameters specified by Client and sends it to Binder Driver;
- **Step 3**: Server continually reads from Binder Driver and unwraps the Parcel addressed to itself;
- **Step 4**: Execute and return.

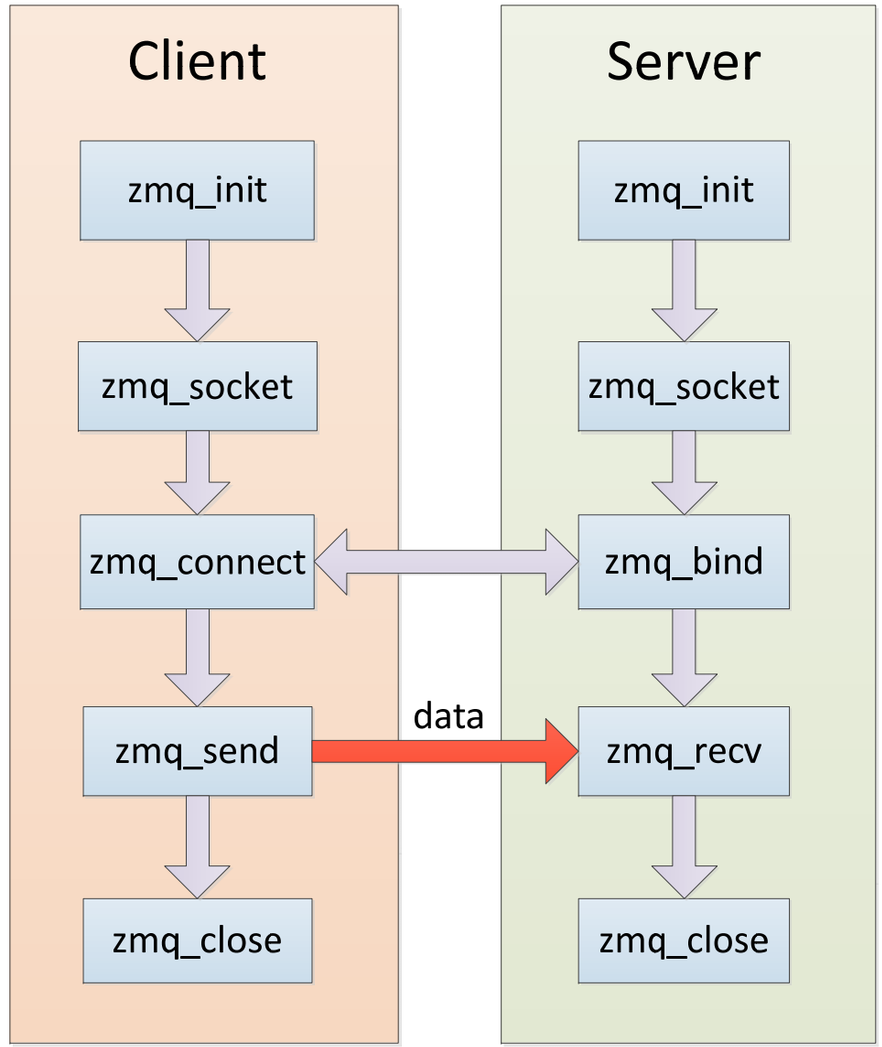


Implementation of ZeroMQ

ØMQ

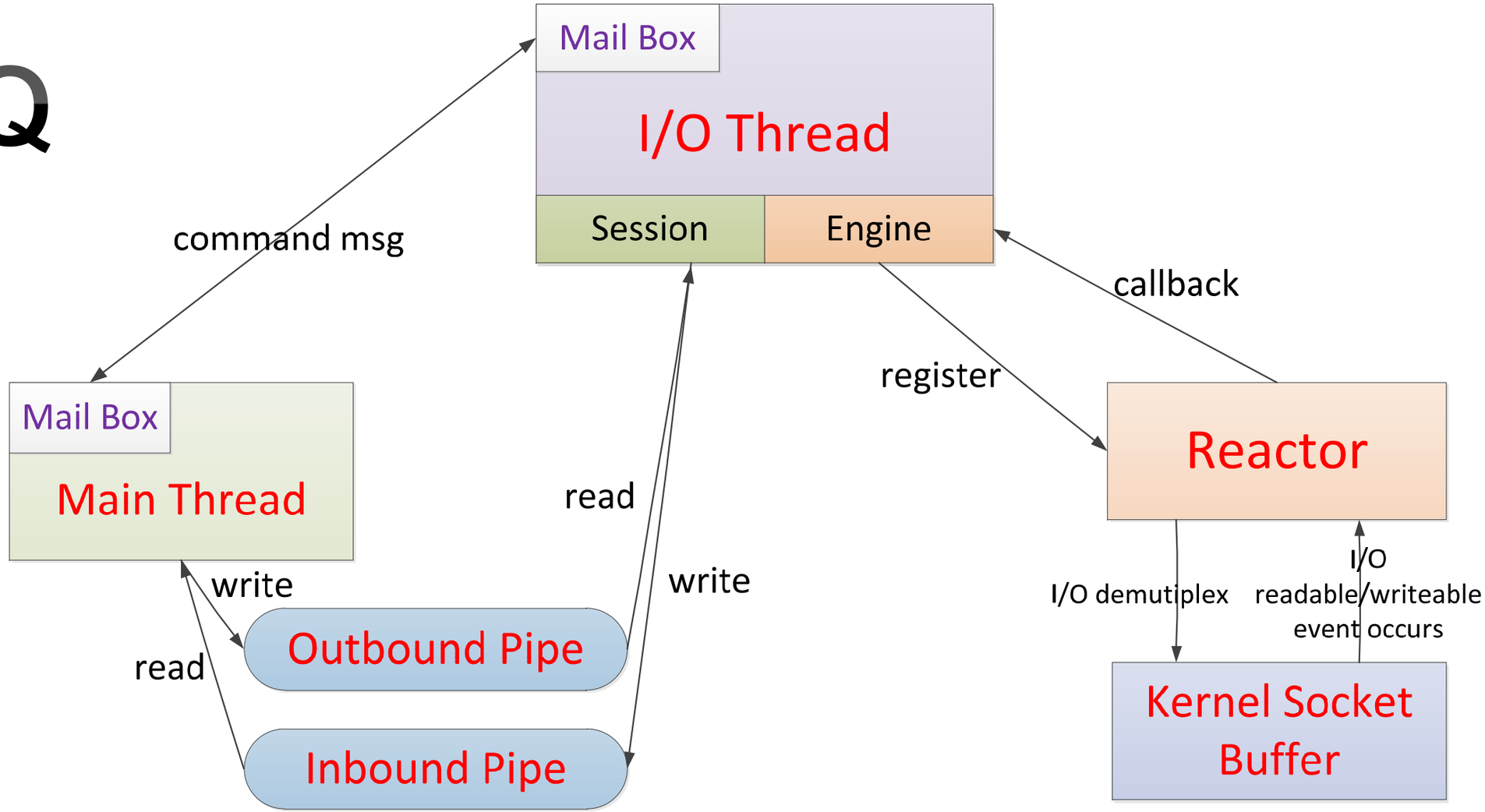
Asynchronous communication

- 24 APIs
- Multiple protocols
  - IPC, TCP, in-process
- Multiple communication modes
  - pair, pub-sub, req-rep, push-pull
- Multiple languages
  - C, C++, Java, .NET, Python
- Cross-platform
  - Linux, Windows, OS X
- Run as a library



Implementation of ZeroMQ

ØMQ



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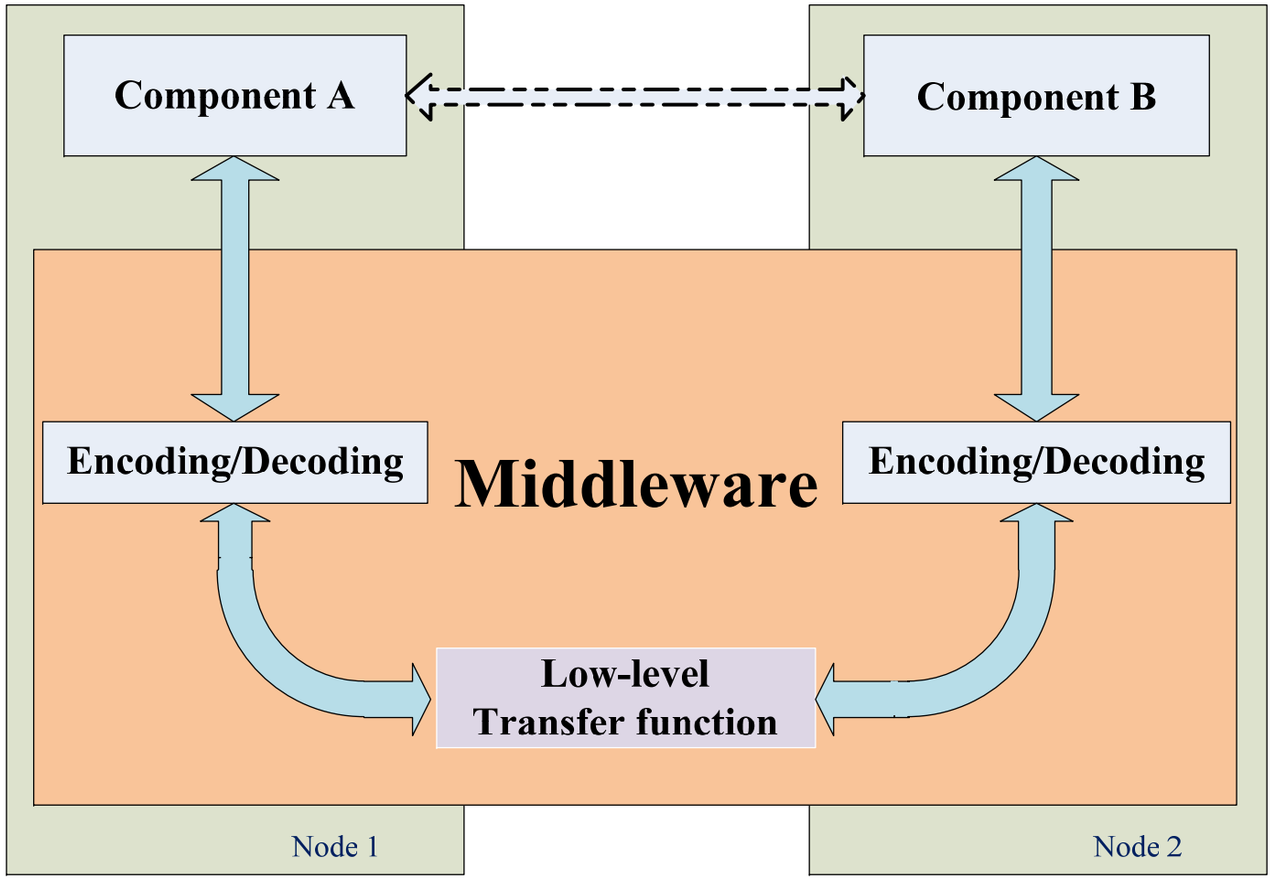
Efficiency analysis

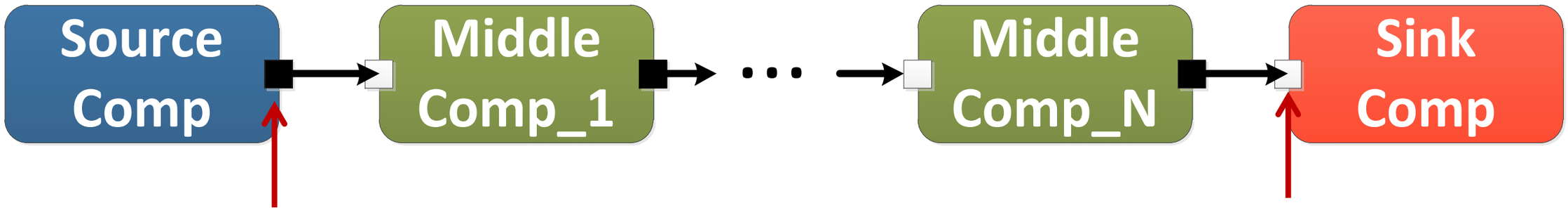


- Encoding
  - Data formatting
  - Serialization
  - Data Checking
- Transfer function
  - Message queue
  - Shared memory
  - TCP Socket
- Others
  - System schedule
  - Thread management

General SDR Platform ZLSDR-1000

- Baseband chip: ZYNQ 7030 SoC
- CPU: dual-core ARM Cortex-A9
  - Frequency: 667MHz;
- FPGA: Kintex-7
  - logic cell: 125K;
  - DSP slices: 400
  - BARM: 1MB
- Memory size: 1GB
- OS: Linux 3.17

Test environment and methods



T1=clock_gettime()

T2=clock_gettime()

T1: the first time of sending

T2: the 1000000th time of receiving

Transfer delay = (T2-T1) /1000000

Monte Carlo simulation of 500 trials

Results

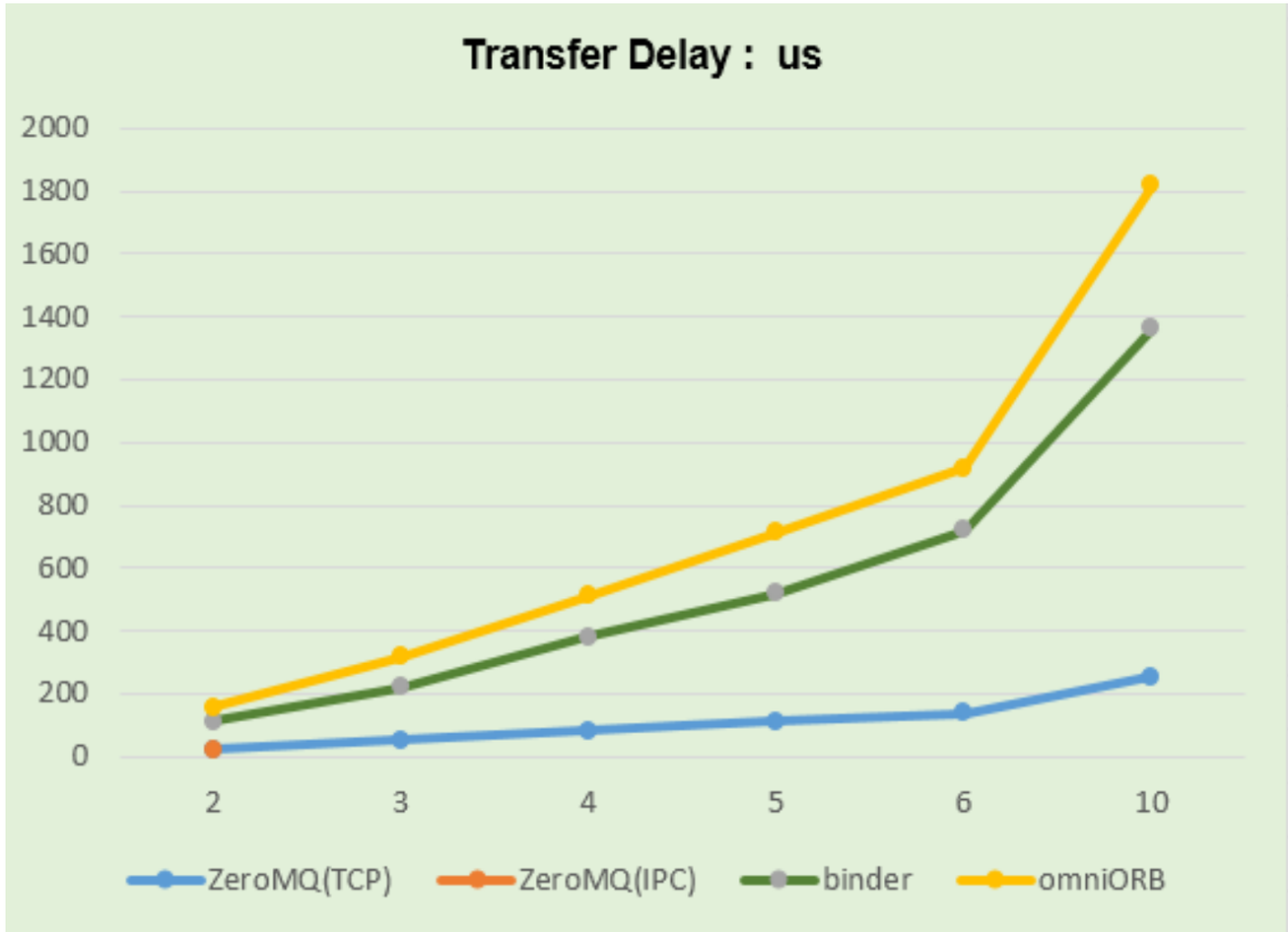
Transfer delay of omniORB, Binder and ZeroMQ

Parameters

- Packet size: 1024 bytes
- The number of components varies from 2 to 10

Results

- The delay of ZeroMQ is 1/5 of binder and 1/7 of omniORB.
- Transfer delay increases almost linearly with the number of components.



Results

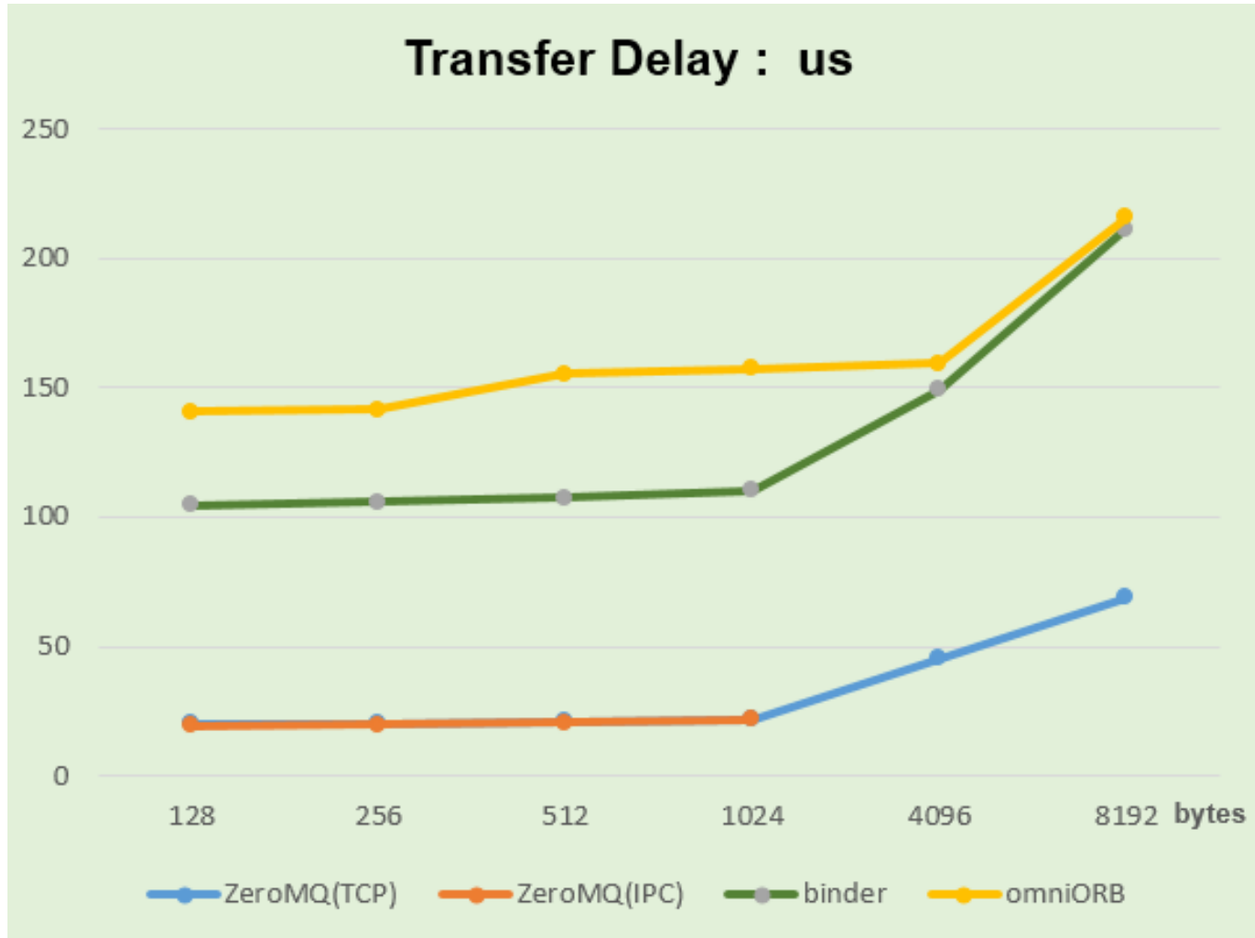
Transfer delay of omniORB, Binder and ZeroMQ

Parameters

- The number of components is 2
- Packet size varies from 1024 to 8192 bytes

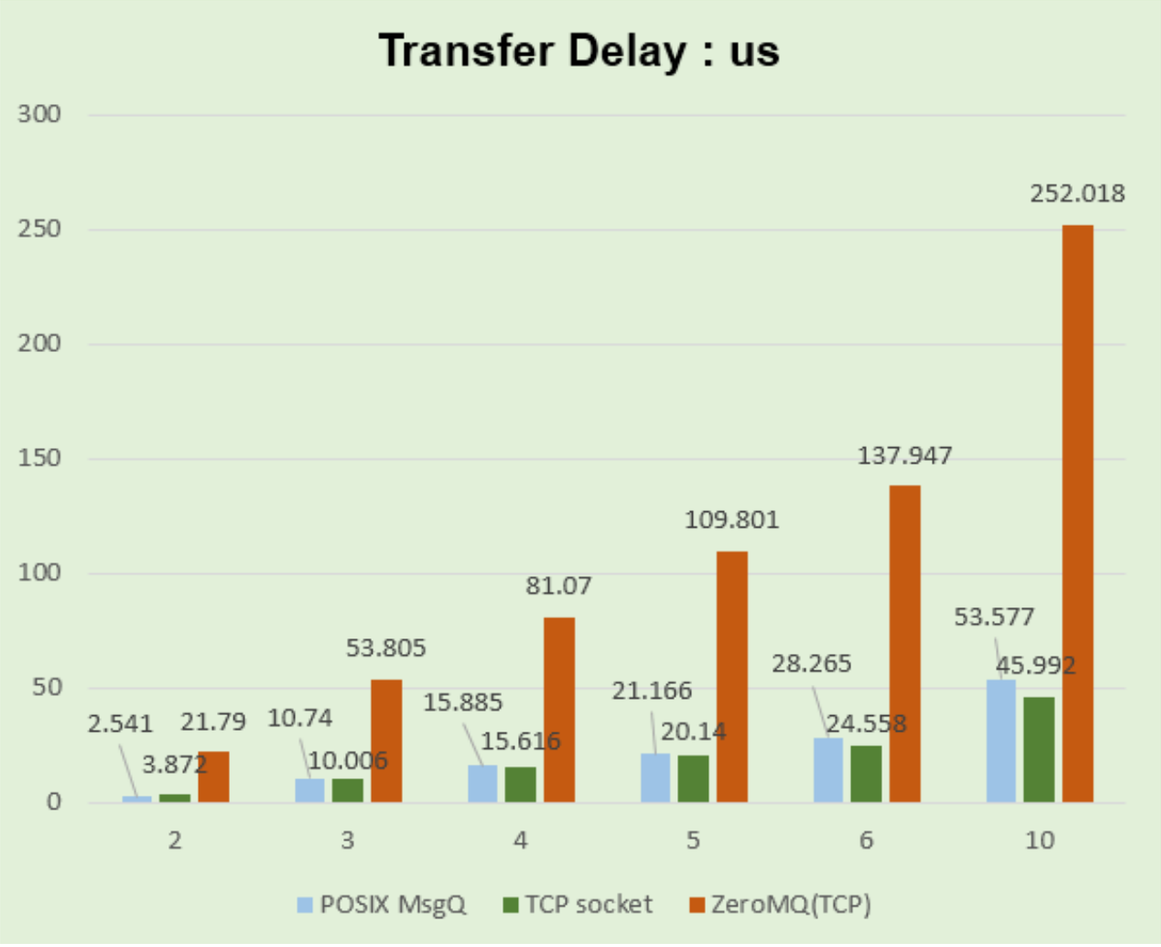
Results

- The delay of ZeroMQ is 1/3 of omniORB when packet size is larger than 1024 bytes.
- The delay of Binder is similar to omniORB when packet size is larger than 4096 bytes.



Results

Transfer delay between ZeroMQ-TCP and low-level transfer functions



Parameters

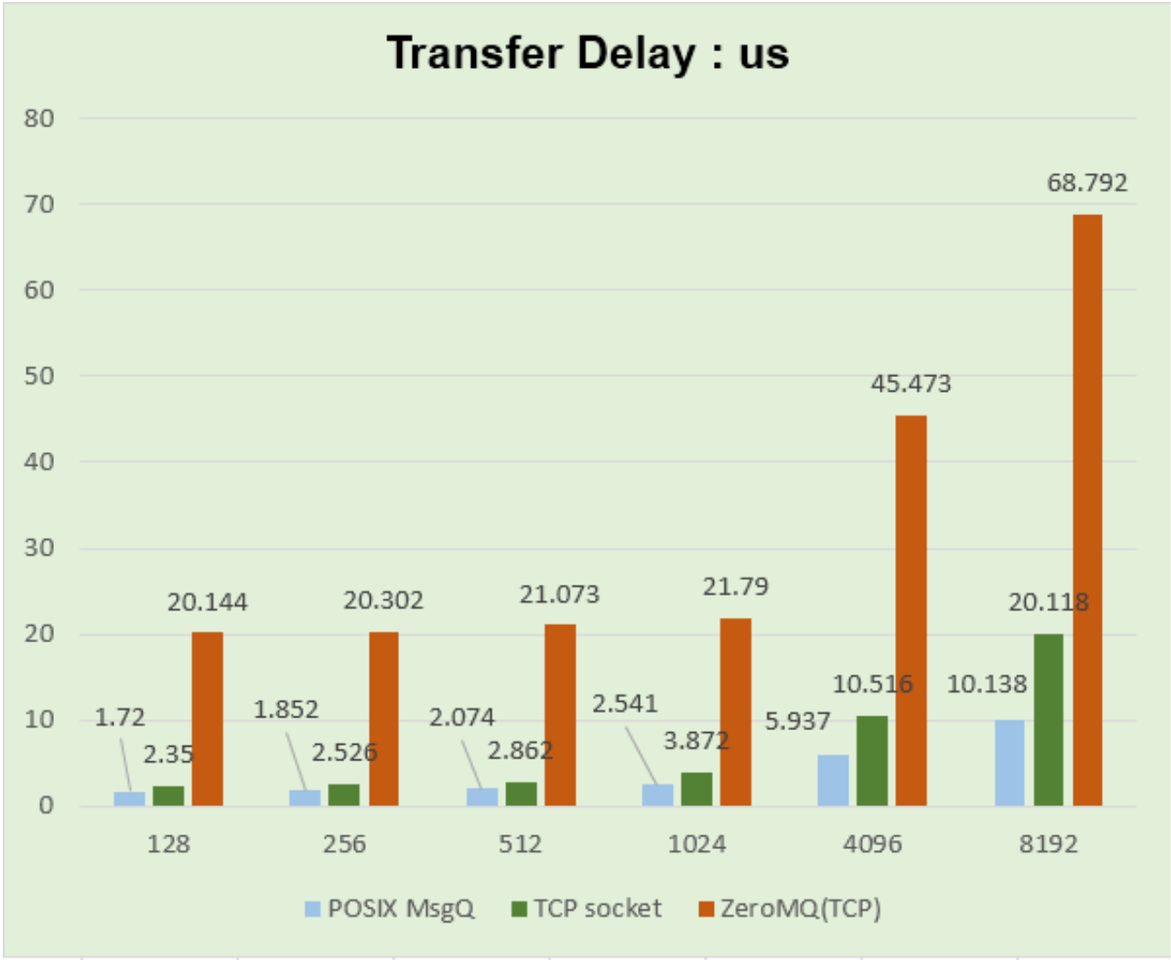
- Packet size: 1024 bytes
- The number of components varies from 2 to 10

Results

- The delay of ZeroMQ is 5.6 times of TCP socket.
- The efficiency of Message Queue is similar to TCP socket

Results

Transfer delay between ZeroMQ-TCP and low-level transfer functions



Parameters

- The number of components is 2
- Packet size varies from 128 to 8192 bytes

Results

- When packet size is smaller than 1024 bytes, the delays remain almost constant.
- More delays occur when packet size exceed 1024 bytes

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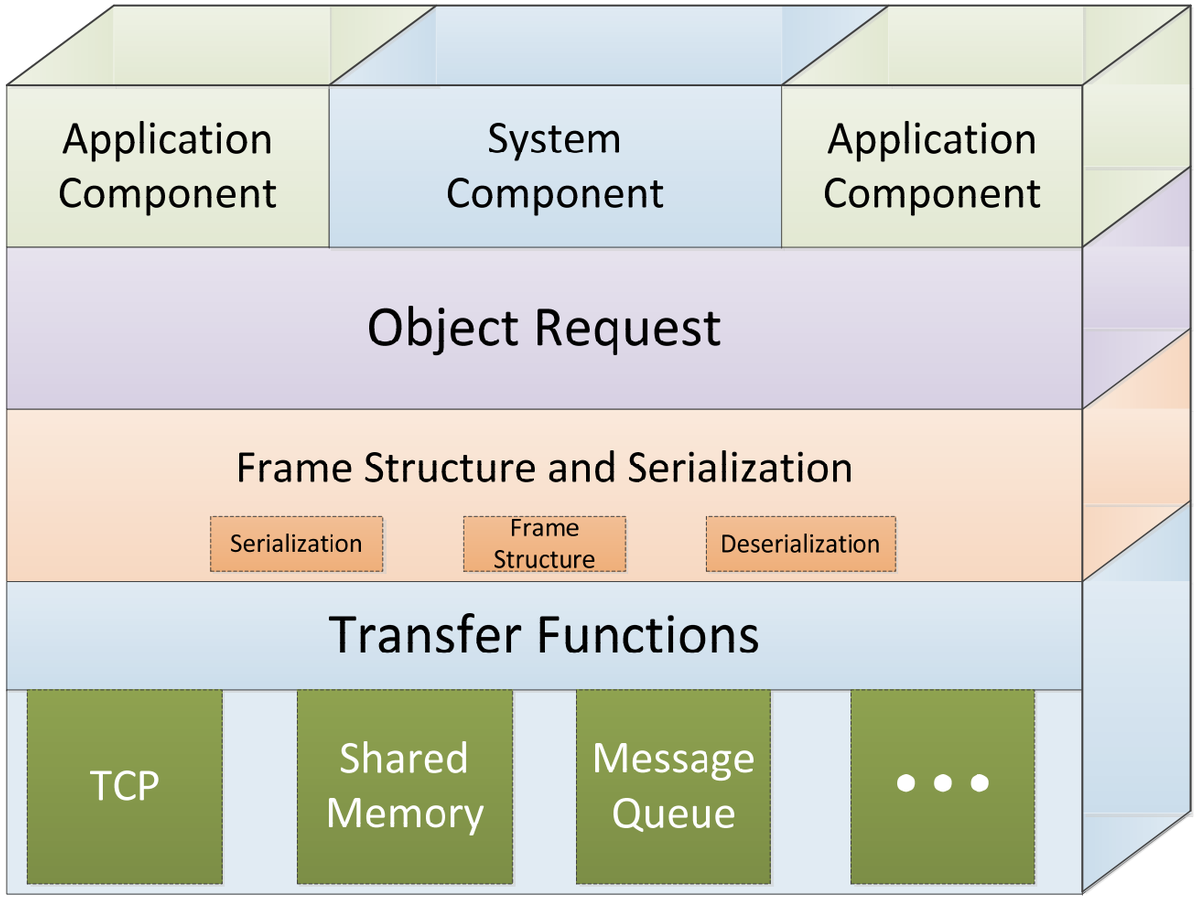
Hierarchical Structure of KD-RPC



Main features

- Based on RPC
- Self-adaptive and pluggable transfer functions
- Self-defined frame structure and serialization approach

KD-RPC Tests

Packet size (bytes)		128	256	512	1024	4096	8192
TCP socket	VM	0.344	0.349	0.379	0.477	0.825	1.660
	ARM	2.350	2.526	2.862	3.872	10.52	20.12
KD-RPC	VM	3.877	4.558	4.457	4.969	7.046	11.62
	ARM	69.05	72.76	79.01	90.20	157.6	257.4
omniORB	VM	48.49	49.65	47.46	48.26	48.15	55.43
	ARM	140.6	141.4	155.1	157.4	159.3	215.9

Testbeds

- VM
  - Linux Ubuntu 4.2
  - Intel 3.2 GHz dual-core processor
  - 1 GB RAM
- ZLSDR-1000

Performance degradation

- KD-RPC performs not good as omniORB in ZLSDR-1000 when packet size is larger than 4096 bytes

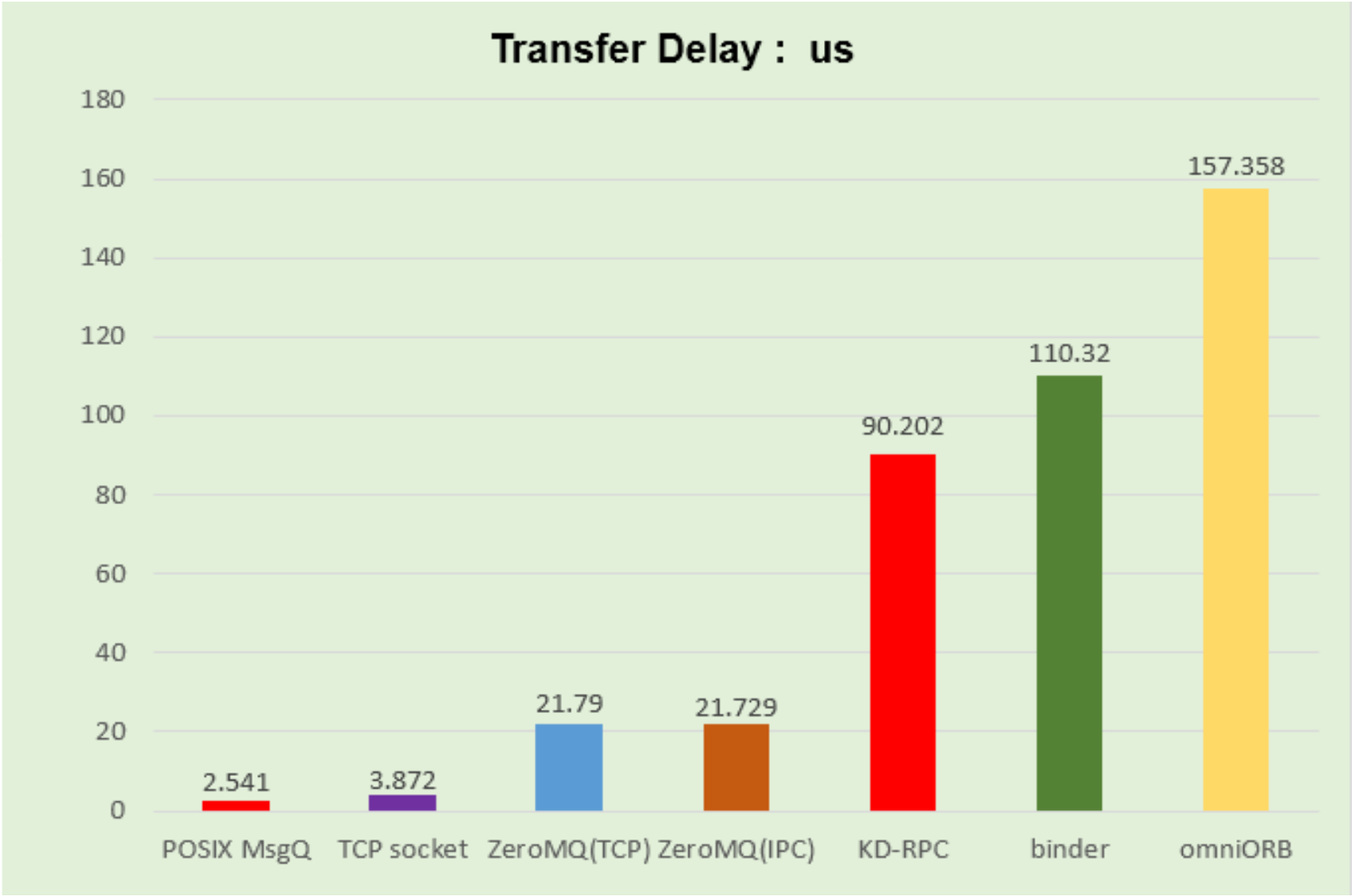
Comparison with KD-RPC

Parameters

- The number of components: 2
- Packet size: 1024 bytes

Results

Averagely, the efficiency of KD-RPC improves by 18.24% compared with Binder, and 42.68% compared with omniORB.



Conclusion

- ZeroMQ achieves better performance compared with Binder and OmniORB.
- Encapsulation of low level transfer functions worse the efficiency more than 10 times.
- Averagely, the efficiency of KD-RPC improves by 18.24% compared with Binder, and 42.68% compared with omniORB

There is a tradeoff between universality and efficiency.

Thank you !

谢谢！