

- [ROS 2 / Fast-DDS Inter-Process Performance Test Result](#)
 - [Overview](#)
 - [Test Method](#)
 - [ShmData Structure](#)
 - [Pseudo Code](#)
 - [Test Environment](#)
 - [Test Statistics](#)
 - [Test Result on Skylake](#)
 - [Test Result on Raspi4](#)

ROS 2 / Fast-DDS Inter-Process Performance Test Result

Overview

In this document, it focuses on inter-processes ROS2 Fast-DDS performance comparison of UDP mode and zero copy mode on local host machine.

Test Method

This method focuses on inter-process test in the same local host machine, which target for **UDP** and **zero copy**. The test steps:

ShmData Structure

ShmData is a data structure shared in publisher and subscribers.

```
typedef struct{  
    int need_subscriber_count;  
    int send_times;  
    long int msg_size;  
    struct timespec ts_transmission_end;  
}ShmData;
```

1. need_subscriber_count

At initialization stage

- Publisher will set this value on how many subscribers should be launched. And check if this value is changed to 0 which means all subscribers ready.
- After a subscriber is launched, it will decrease this value by 1.

At performance execution stage.

For one test

- Publisher will set this value on how many subscribers should receive sent message before sending a message. And check if this value is changed to 0 which means all subscribers receive this message.
- Once a subscriber receive a message, it will decrease this value by 1.

2. send_times

How many times to send messages for publisher.

- Publisher will set this value. And this value is decreased by 1 after finish one test.
- Subscriber read this and know how many messages will be received.

3. msg_size

Message size.

- Publisher will set this value at first.
- Subscriber read this value at first to know the size of received message.

4. ts_transmission_end

This value records the timestamp of the last received message.

For one test

- Publisher will record start timestamp and then send message
- While a subscriber receive the message, record the timestamp. If recorded timestamp is later than `ts_transmission_end`, update `ts_transmission_end`. Otherwise, do nothing.

While `need_subscriber_count` is 0, publisher will get `ts_transmission_end`. Get the latency by `ts_transmission_end - start timestamp` for this test.

NOTE

When access **ShmData**, publisher and subscribers will use lock to avoid race condition.

Pseudo Code

1. Initialization stage

Publisher:

```
Create shared memory for ShmData
Map ShmData
Initialize ShmData structure
Loop wait all subscribers startup by checking need_subscriber_count
```

Subscriber:

```
Open shared memory for ShmData
```

```
Map ShmData
```

```
need_subscriber_count--
```

2. Execute test

Publisher:

```
var duration_list = []
for i = 0, i < send_times, i++ do
  time_start = gettime()
  if (Loaned Message)
    msg = loan_message()
  else
    msg = get_msg()
  end if
  publish msg
  Loop wait all subscribers complete receive msg by checking need_subscriber_count
  time_end = ts_transmission_end
  duration = time_end - time_start
  push duration to duration_list
end for
```

Subscriber:

```
var send_times_count = 0
while True do
  wait for msg
  current_time = gettime()
  if current_time > ts_transmission_end
    ts_transmission_end = current_time
  end if
  send_times_count++
  if send_times_count > ShmData->send_times_count
    exit
  end if
end while
```

3. Get average latency

Publisher:

```
total_time = sum(duration_list)
average_latency = total_time / send_times
print result
```

Test Environment

- Hardware

- Skylake
GenuineIntel Intel(R) Core(TM) i7-6700K CPU(x8) @ 4.00GHz, memory 15.6GiB
 - Raspberry Pi 4 Model B Rev 1.1
Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz, memory 3.7GiB
 - Software
 - Host
 - Ubuntu 20.04 focal on Skylake
Use docker environment to do test
 - Docker version 20.10.2 with Ubuntu 20.04.1
 - Ubuntu 20.04 focal on Raspi4
 - Fast-DDS (2.3.x)
 - rosidl_typesupport_fastrtps
commit_id: [748be563227b889e07ab516460e17813cdf7d338](#)
 - rmw_fastrtps
commit_id: [7cb3bd0f73f332f9c27caf505b5bcd1b055c0ec7](#)
- ros2.repos.20210524 includes the detailed version of ROS2's repositories.
[ros2.repos.20210524](#)

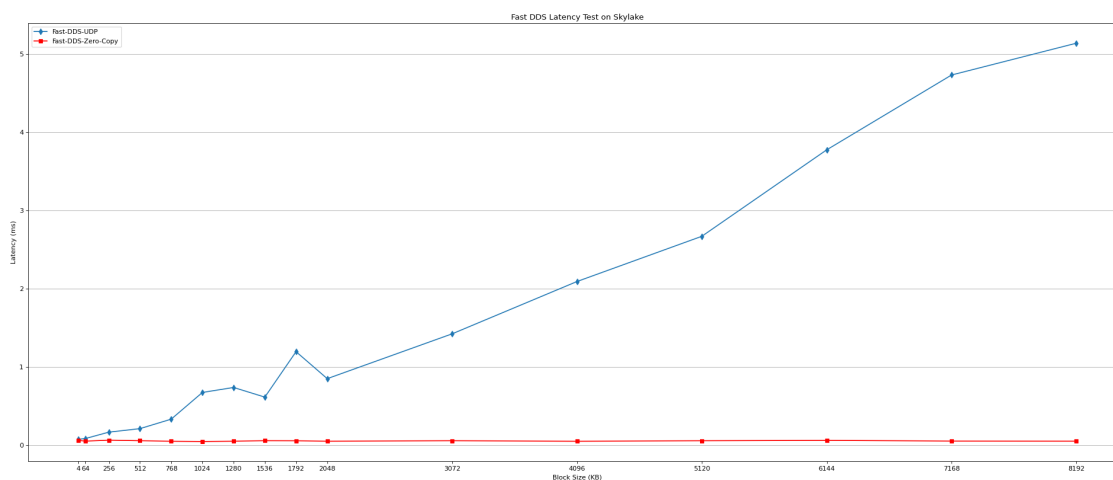
Test Statistics

Test Result on Skylake

- The result with Publisher:Subscriber(1:1)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	0.072992034	0.059874903
64	0.082284167	0.049027614
256	0.164243177	0.061996143
512	0.209163874	0.054701805
768	0.330303490	0.048000704
1024	0.671930134	0.044825777
1280	0.735634863	0.048729174
1536	0.612357616	0.054815959
1792	1.193488359	0.053802017

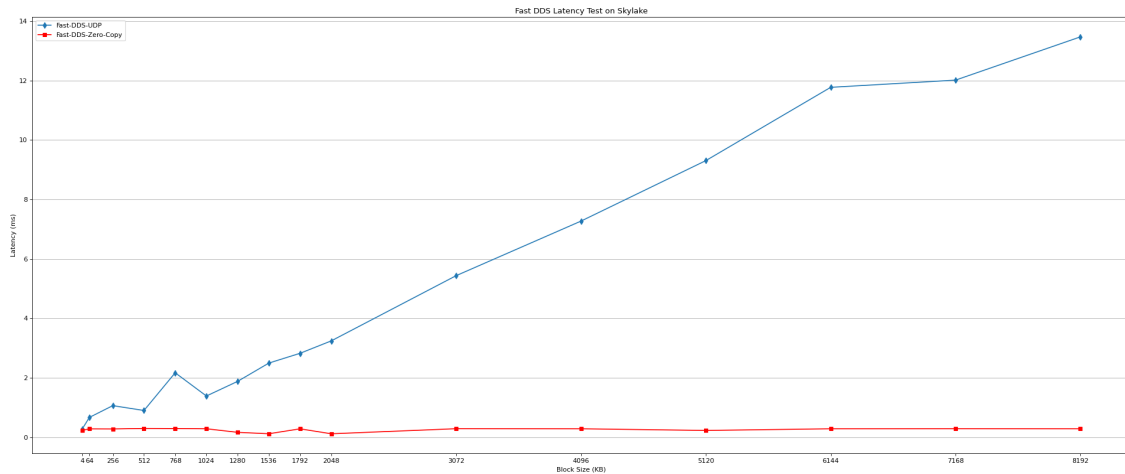
buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
2048	0.848206401	0.048542883
3072	1.421408534	0.054475304
4096	2.090303421	0.048000734
5120	2.668680429	0.054267228
6144	3.774027586	0.059257183
7168	4.730921745	0.050096642
8192	5.137895107	0.049148630



- The result with Publisher:Subscriber(1:4)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	0.265962601	0.231096774
64	0.665694118	0.280817330
256	1.062344313	0.278138191
512	0.899291813	0.296390116
768	2.167341948	0.293203384
1024	1.386488199	0.284438938
1280	1.878338456	0.164614007

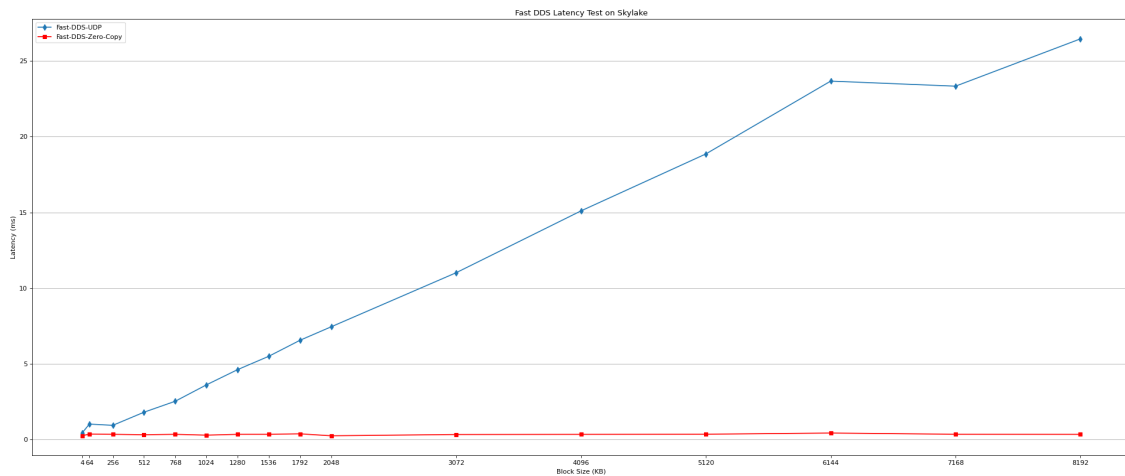
buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
1536	2.493585587	0.116823733
1792	2.822519541	0.282442659
2048	3.240115643	0.115747653
3072	5.433115959	0.286244929
4096	7.268281937	0.283692211
5120	9.302710533	0.228206754
6144	11.767238617	0.283502430
7168	12.009871483	0.285344630
8192	13.464207649	0.283798784



- The result with Publisher:Subscriber(1:8)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	0.406065762	0.230438724
64	1.003383875	0.340209275
256	0.919258833	0.327557832
512	1.786569834	0.296457350
768	2.510823488	0.326349556

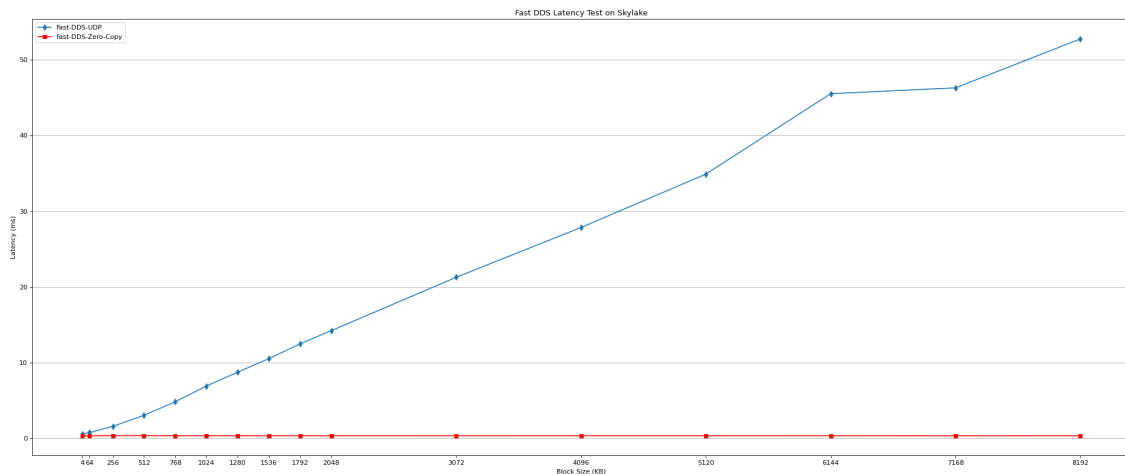
buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
1024	3.595084667	0.270092040
1280	4.603167534	0.325380474
1536	5.486700058	0.326010585
1792	6.544660568	0.357302606
2048	7.436399937	0.228651553
3072	11.007935524	0.313668430
4096	15.096018791	0.322926968
5120	18.861833572	0.330254227
6144	23.677947998	0.412348151
7168	23.343208313	0.327214479
8192	26.469772339	0.323325157



- The result with Publisher:Subscriber(1:16)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	0.594572842	0.352493405
64	0.778303146	0.355675071
256	1.599105835	0.371394813

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
512	3.055542231	0.364849120
768	4.843247414	0.358717173
1024	6.924832821	0.356748015
1280	8.751419067	0.356789410
1536	10.540825844	0.356737107
1792	12.481265068	0.357502311
2048	14.234090805	0.357203335
3072	21.277473450	0.359017670
4096	27.851232529	0.357484549
5120	34.902462006	0.356188327
6144	45.522052765	0.359974504
7168	46.290973663	0.353421599
8192	52.757305145	0.358120143

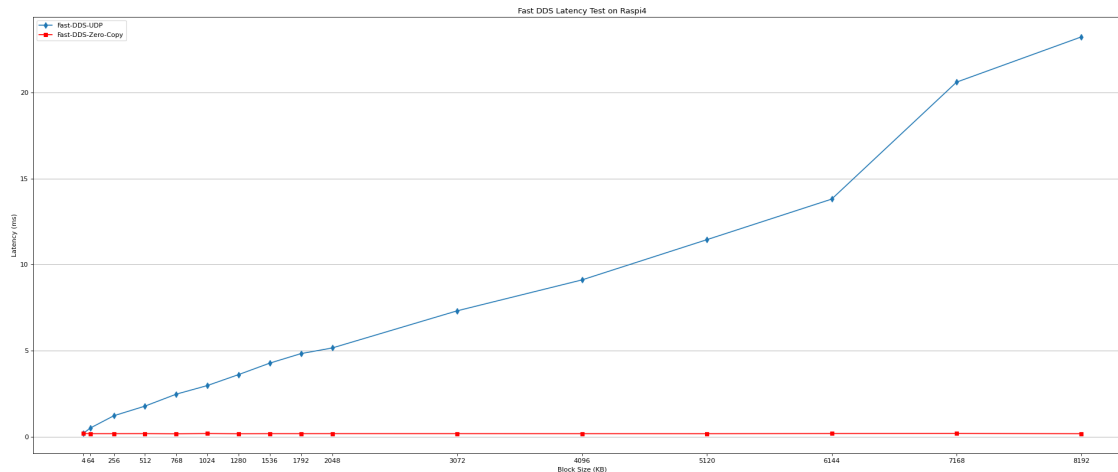


Test Result on Raspi4

- The result with Publisher:Subscriber(1:1)

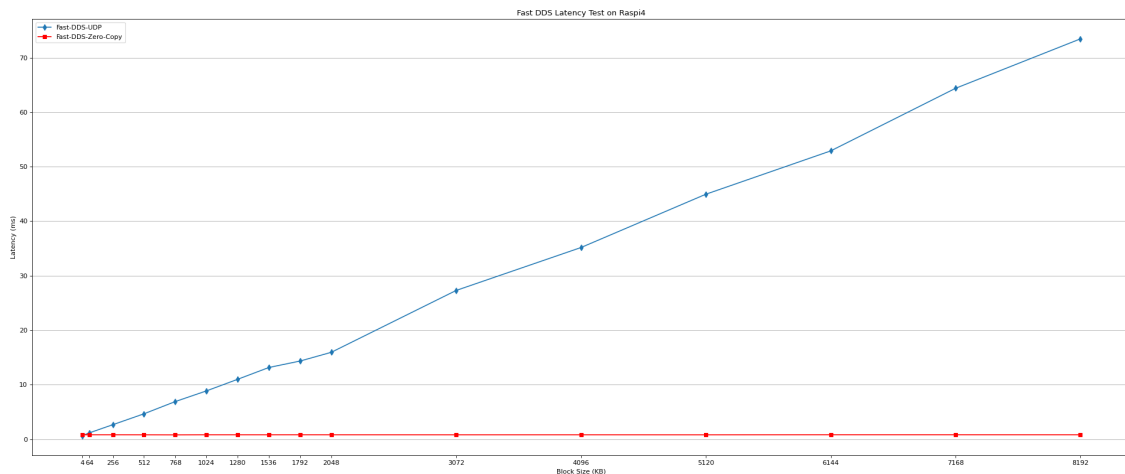
buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
-----------------	-----------------	-----------------------

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	0.187354609	0.190509856
64	0.510696948	0.181941450
256	1.221628547	0.182359874
512	1.782779932	0.184978768
768	2.475743294	0.175652459
1024	2.977734327	0.189393163
1280	3.613872290	0.177818909
1536	4.280744076	0.182780057
1792	4.833659172	0.182840139
2048	5.160327911	0.183800846
3072	7.316624165	0.183573425
4096	9.112275124	0.181847185
5120	11.448625565	0.180911586
6144	13.805671692	0.188290060
7168	20.598770142	0.191719875
8192	23.227771759	0.180797070



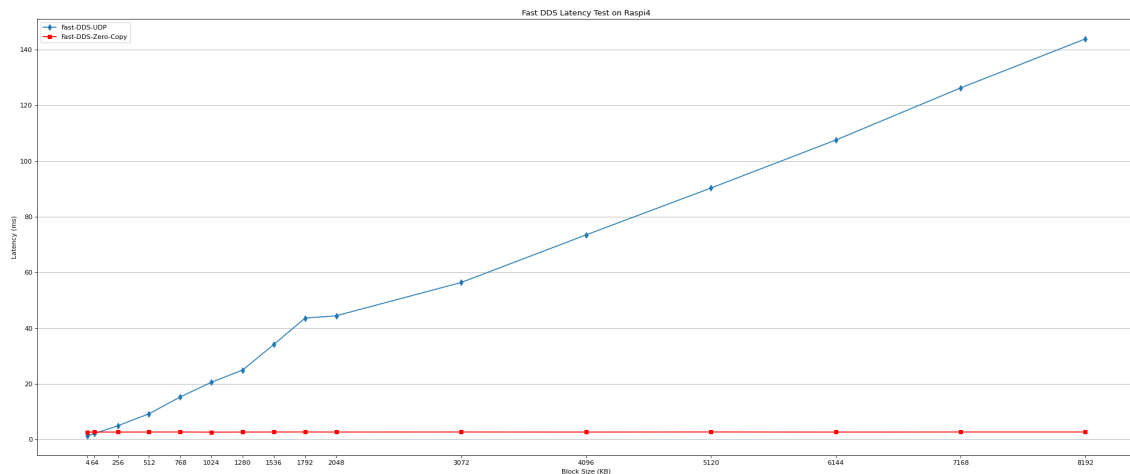
- The result with Publisher:Subscriber(1:4)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	0.634309292	0.809057295
64	1.170563221	0.816528201
256	2.665178299	0.815757275
512	4.666846275	0.810051918
768	6.905868530	0.800092101
1024	8.865759850	0.814690292
1280	10.993546486	0.813913941
1536	13.159967422	0.812971890
1792	14.342733383	0.817552209
2048	15.944346428	0.814220548
3072	27.291454315	0.809531331
4096	35.166030884	0.811963320
5120	44.942707062	0.807762325
6144	52.891380310	0.823266387
7168	64.376235962	0.821025193
8192	73.442497253	0.816422164



- The result with Publisher:Subscriber(1:8)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	1.353186727	2.662269592
64	2.140512943	2.700565577
256	4.941785336	2.691175461
512	9.256760597	2.707498789
768	15.292686462	2.714429140
1024	20.586849213	2.674475908
1280	24.956541061	2.692342997
1536	34.160148621	2.711474895
1792	43.610454559	2.716866732
2048	44.463840485	2.705099583
3072	56.406391144	2.714566231
4096	73.487831116	2.695454359
5120	90.323944092	2.723086596
6144	107.552085876	2.690341711
7168	126.279281616	2.715807676
8192	143.903533936	2.716248512



- The result with Publisher:Subscriber(1:16)

buffer_size(KB)	udp latency(ms)	zero copy latency(ms)
4	2.572726965	9.389266968
64	4.744718552	9.362874985
256	9.973016739	9.400006294
512	19.160232544	9.325755119
768	31.152090073	9.359561920
1024	46.982620239	9.399212837
1280	52.496402740	9.432170868
1536	62.475627899	9.417201996
1792	75.710334778	9.366494179
2048	82.776580811	9.417152405
3072	111.598541260	9.350654602
4096	142.685180664	9.366931915
5120	177.493301392	9.385908127
6144	211.485870361	9.302979469
7168	250.833816528	9.361763000
8192	286.016998291	9.255361557

