

Ordered Delivery

The output files for 2 worker processes. It can be seen that the messages are delivered in the same order.

Running "diff out2 out3 | grep Delivered" confirms the order of delivery.

out2	out3
<pre> Process ID = 2 Listener Proc started listening on port 44444 Sent msg 364458395 to server Sent msg 218063339 to server <-- Queued seq=2 dat=364458395 --> Delivered seq=1 dat=346997813 --> Delivered seq=2 dat=364458395 --> Delivered seq=3 dat=242972265 Sent msg 600544824 to server Sent msg 981091995 to server Sent msg 832605629 to server --> Delivered seq=4 dat=218063339 <-- Queued seq=8 dat=981091995 Sent msg 676436191 to server --> Delivered seq=5 dat=145375561 <-- Queued seq=9 dat=654061332 --> Delivered seq=6 dat=600544824 Sent msg 522254681 to server --> Delivered seq=7 dat=400363217 --> Delivered seq=8 dat=981091995 --> Delivered seq=9 dat=654061332 Sent msg 910420842 to server <-- Queued seq=16 dat=910420842 <-- Queued seq=17 dat=606947229 <-- Queued seq=12 dat=676436191 Sent msg 760381009 to server --> Delivered seq=10 dat=832605629 --> Delivered seq=11 dat=555070421 --> Delivered seq=12 dat=676436191 --> Delivered seq=13 dat=450957462 --> Delivered seq=14 dat=522254681 Sent msg 69207834 to server --> Delivered seq=15 dat=348169789 --> Delivered seq=16 dat=910420842 --> Delivered seq=17 dat=606947229 Sent msg 457186842 to server </pre>	<pre> Process ID = 3 Listener Proc started listening on port 44445 Sent msg 346997813 to server Sent msg 242972265 to server <-- Queued seq=2 dat=364458395 Sent msg 145375561 to server --> Delivered seq=1 dat=346997813 --> Delivered seq=2 dat=364458395 --> Delivered seq=3 dat=242972265 Sent msg 400363217 to server Sent msg 654061332 to server Sent msg 555070421 to server --> Delivered seq=4 dat=218063339 <-- Queued seq=8 dat=981091995 --> Delivered seq=5 dat=145375561 <-- Queued seq=9 dat=654061332 Sent msg 450957462 to server --> Delivered seq=6 dat=600544824 --> Delivered seq=7 dat=400363217 --> Delivered seq=8 dat=981091995 --> Delivered seq=9 dat=654061332 Sent msg 348169789 to server <-- Queued seq=16 dat=910420842 Sent msg 606947229 to server <-- Queued seq=17 dat=606947229 <-- Queued seq=12 dat=676436191 --> Delivered seq=10 dat=832605629 --> Delivered seq=11 dat=555070421 --> Delivered seq=12 dat=676436191 --> Delivered seq=13 dat=450957462 Sent msg 506920674 to server --> Delivered seq=14 dat=522254681 --> Delivered seq=15 dat=348169789 --> Delivered seq=16 dat=910420842 --> Delivered seq=17 dat=606947229 Sent msg 46138557 to server </pre>

Running 3 worker processes: the order of delivery is preserved across all processes.

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dozer@dozer-VirtualBox: ~/os/proj2/assl dozer@dozer-VirtualBox: ~/os/proj2/assl dozer@dozer-VirtualBox: ~/os/proj2/ dozer@dozer-VirtualBox: ~/os/proj2/
Forwarding seq=29 dat=661865115 to portnum=33332 Sent msg 72828903 to server --> Delivered seq=12 dat=147411289 --> Delivered seq=13 dat=73705647
Forwarding seq=29 dat=661865115 to portnum=22221 --> Delivered seq=14 dat=98274194 Sent msg 48552604 to server --> Delivered seq=13 dat=73705647
Forwarding seq=29 dat=661865115 to portnum=33331 --> Delivered seq=15 dat=528672030 --> Delivered seq=14 dat=98274194
Forwarding seq=32 dat=201241306 to portnum=33332 --> Delivered seq=16 dat=264336018 --> Delivered seq=15 dat=528672030
Forwarding seq=32 dat=201241306 to portnum=22221 --> Delivered seq=17 dat=352448022 --> Delivered seq=16 dat=264336018
Forwarding seq=32 dat=201241306 to portnum=33331 --> Delivered seq=18 dat=372729965 --> Delivered seq=17 dat=352448022
Forwarding seq=32 dat=201241306 to portnum=22221 --> Delivered seq=19 dat=186364985 --> Delivered seq=18 dat=372729965
Forwarding seq=32 dat=201241306 to portnum=33331 --> Delivered seq=20 dat=248486645 --> Delivered seq=19 dat=186364985
Forwarding seq=32 dat=201241306 to portnum=22221 Sent msg 992797670 to server --> Delivered seq=20 dat=248486645
Forwarding seq=32 dat=201241306 to portnum=33331 Sent msg 301861957 to server Sent msg 661865115 to server --> Delivered seq=21 dat=225144396
Forwarding seq=33 dat=148314828 to portnum=33332 --> Delivered seq=21 dat=225144396 Sent msg 201241306 to server --> Delivered seq=21 dat=225144396
Forwarding seq=33 dat=148314828 to portnum=22221 --> Queued seq=24 dat=72828903 --> Delivered seq=22 dat=112572201
Forwarding seq=33 dat=148314828 to portnum=33331 --> Queued seq=27 dat=992797670 --> Queued seq=25 dat=36414454
Forwarding seq=33 dat=148314828 to portnum=22221 Sent msg 148314828 to server --> Queued seq=28 dat=496398838
Forwarding seq=33 dat=148314828 to portnum=33331 --> Queued seq=30 dat=301861957 --> Queued seq=31 dat=150930981
Forwarding seq=33 dat=148314828 to portnum=22221 --> Delivered seq=22 dat=112572201 --> Delivered seq=23 dat=150096266
Forwarding seq=33 dat=148314828 to portnum=33331 --> Queued seq=25 dat=36414454 --> Delivered seq=24 dat=72828903
Forwarding seq=34 dat=74157417 to portnum=22221 --> Queued seq=28 dat=496398838 --> Delivered seq=25 dat=36414454
Forwarding seq=34 dat=74157417 to portnum=33331 --> Queued seq=31 dat=150930981 --> Delivered seq=26 dat=48552604
Forwarding seq=34 dat=74157417 to portnum=22221 --> Delivered seq=23 dat=150096266 --> Delivered seq=27 dat=992797670
Forwarding seq=34 dat=74157417 to portnum=33331 --> Delivered seq=24 dat=72828903 --> Delivered seq=28 dat=496398838
Forwarding seq=34 dat=74157417 to portnum=22221 --> Delivered seq=25 dat=36414454 --> Delivered seq=29 dat=661865115
Forwarding seq=34 dat=74157417 to portnum=33331 --> Delivered seq=26 dat=48552604 --> Delivered seq=30 dat=301861957
Forwarding seq=35 dat=98876553 to portnum=22221 --> Delivered seq=27 dat=992797670 --> Delivered seq=31 dat=150930981
Forwarding seq=35 dat=98876553 to portnum=33331 --> Delivered seq=28 dat=496398838 --> Delivered seq=32 dat=201241306
Forwarding seq=35 dat=98876553 to portnum=22221 Sent msg 98876553 to server --> Delivered seq=29 dat=661865115
Forwarding seq=35 dat=98876553 to portnum=33331 --> Delivered seq=30 dat=301861957 --> Delivered seq=33 dat=148314828
Forwarding seq=35 dat=98876553 to portnum=22221 --> Delivered seq=31 dat=150930981 --> Delivered seq=34 dat=74157417
Forwarding seq=35 dat=98876553 to portnum=33331 --> Delivered seq=32 dat=201241306 --> Delivered seq=35 dat=98876553
Forwarding seq=39 dat=917936122 to portnum=33332 Sent msg 537932766 to server Sent msg 358621846 to server --> Delivered seq=33 dat=148314828
Forwarding seq=39 dat=917936122 to portnum=22221 Sent msg 917936122 to server --> Delivered seq=34 dat=74157417
Forwarding seq=39 dat=917936122 to portnum=33331 --> Delivered seq=35 dat=98876553 --> Delivered seq=35 dat=98876553
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When the server receives a message from a client it increments the global timestamp, appends it to the message and forwards the message to all the clients. When a client receives a multicast message from the server, it checks the message's timestamp, if it is one increment above the current time then it is delivered, otherwise it is queued. Whenever a message is delivered the queue is looped over and any message in the queue with a timestamp one increment above the message that was just delivered is popped from the queue and delivered.