ECE 569 Spring 2026 — Lab 1

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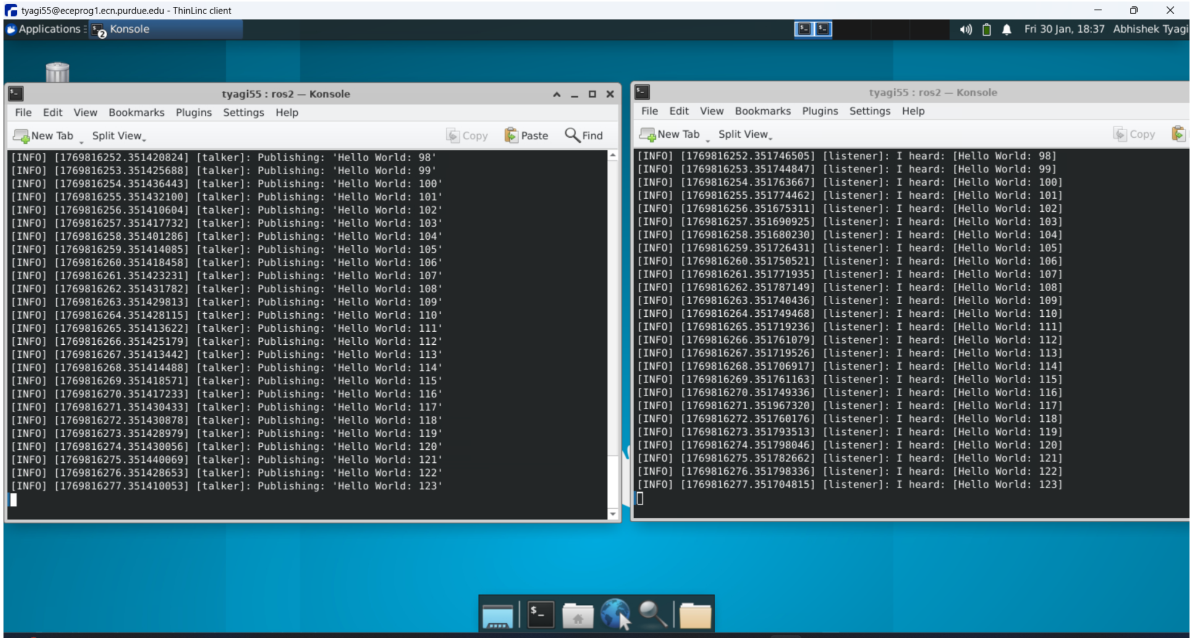
1 Introduction

This lab introduces the fundamentals of ROS 2 communication using the publisher–subscriber model. Both built-in demo nodes and custom Python nodes were executed to understand message passing, node discovery, and topic-based communication in ROS 2 Humble.

2 ROS 2 Demo Nodes

2.1 Talker and Listener

The ROS 2 demo talker and listener nodes were executed to verify correct installation and basic publisher–subscriber communication.



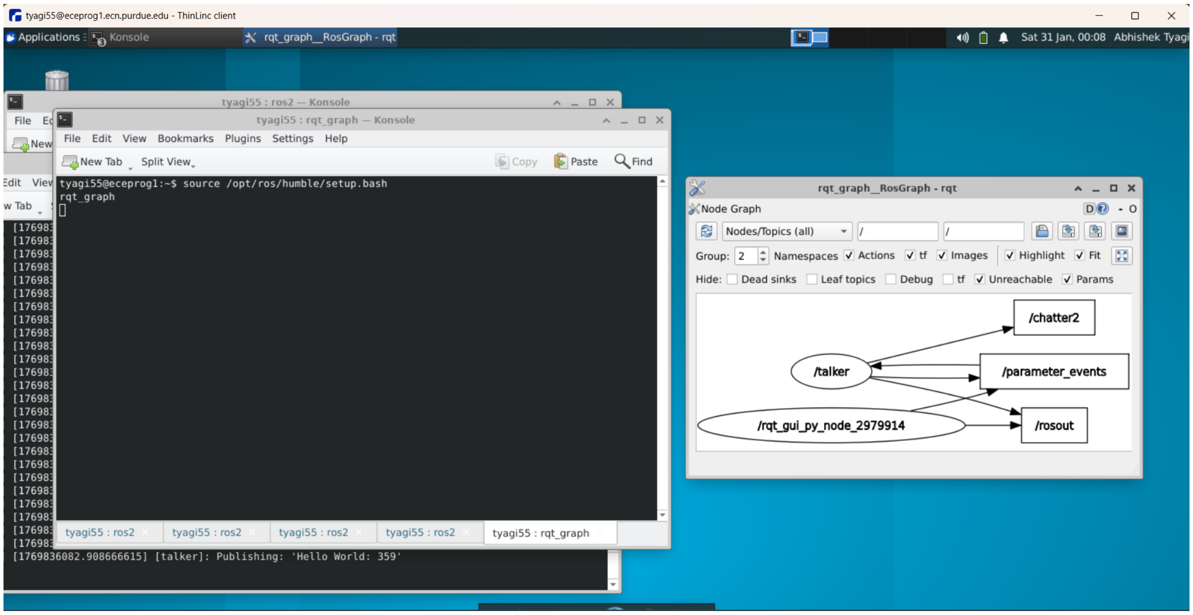
```
[INFO] [1769816252.351420824] [talker]: Publishing: 'Hello World: 98'
[INFO] [1769816253.351425688] [talker]: Publishing: 'Hello World: 99'
[INFO] [1769816254.351436443] [talker]: Publishing: 'Hello World: 100'
[INFO] [1769816255.351432100] [talker]: Publishing: 'Hello World: 101'
[INFO] [1769816256.351410604] [talker]: Publishing: 'Hello World: 102'
[INFO] [1769816257.351417732] [talker]: Publishing: 'Hello World: 103'
[INFO] [1769816258.351401286] [talker]: Publishing: 'Hello World: 104'
[INFO] [1769816259.351414085] [talker]: Publishing: 'Hello World: 105'
[INFO] [1769816260.351418458] [talker]: Publishing: 'Hello World: 106'
[INFO] [1769816261.351423231] [talker]: Publishing: 'Hello World: 107'
[INFO] [1769816262.351431782] [talker]: Publishing: 'Hello World: 108'
[INFO] [1769816263.351429813] [talker]: Publishing: 'Hello World: 109'
[INFO] [1769816264.351428115] [talker]: Publishing: 'Hello World: 110'
[INFO] [1769816265.351413622] [talker]: Publishing: 'Hello World: 111'
[INFO] [1769816266.351425179] [talker]: Publishing: 'Hello World: 112'
[INFO] [1769816267.351413442] [talker]: Publishing: 'Hello World: 113'
[INFO] [1769816268.351414488] [talker]: Publishing: 'Hello World: 114'
[INFO] [1769816269.351418571] [talker]: Publishing: 'Hello World: 115'
[INFO] [1769816270.351417233] [talker]: Publishing: 'Hello World: 116'
[INFO] [1769816271.351430433] [talker]: Publishing: 'Hello World: 117'
[INFO] [1769816272.351430878] [talker]: Publishing: 'Hello World: 118'
[INFO] [1769816273.351428979] [talker]: Publishing: 'Hello World: 119'
[INFO] [1769816274.351430056] [talker]: Publishing: 'Hello World: 120'
[INFO] [1769816275.351440069] [talker]: Publishing: 'Hello World: 121'
[INFO] [1769816276.351428653] [talker]: Publishing: 'Hello World: 122'
[INFO] [1769816277.351410053] [talker]: Publishing: 'Hello World: 123'
```

```
[INFO] [1769816252.351746505] [listener]: I heard: [Hello World: 98]
[INFO] [1769816253.351744847] [listener]: I heard: [Hello World: 99]
[INFO] [1769816254.351763667] [listener]: I heard: [Hello World: 100]
[INFO] [1769816255.351774462] [listener]: I heard: [Hello World: 101]
[INFO] [1769816256.351675311] [listener]: I heard: [Hello World: 102]
[INFO] [1769816257.351690925] [listener]: I heard: [Hello World: 103]
[INFO] [1769816258.351680230] [listener]: I heard: [Hello World: 104]
[INFO] [1769816259.351726431] [listener]: I heard: [Hello World: 105]
[INFO] [1769816260.351750521] [listener]: I heard: [Hello World: 106]
[INFO] [1769816261.351771935] [listener]: I heard: [Hello World: 107]
[INFO] [1769816262.351787149] [listener]: I heard: [Hello World: 108]
[INFO] [1769816263.351740436] [listener]: I heard: [Hello World: 109]
[INFO] [1769816264.351749468] [listener]: I heard: [Hello World: 110]
[INFO] [1769816265.351719236] [listener]: I heard: [Hello World: 111]
[INFO] [1769816266.351761079] [listener]: I heard: [Hello World: 112]
[INFO] [1769816267.351719526] [listener]: I heard: [Hello World: 113]
[INFO] [1769816268.351706917] [listener]: I heard: [Hello World: 114]
[INFO] [1769816269.351761163] [listener]: I heard: [Hello World: 115]
[INFO] [1769816270.351749336] [listener]: I heard: [Hello World: 116]
[INFO] [1769816271.351967320] [listener]: I heard: [Hello World: 117]
[INFO] [1769816272.351760176] [listener]: I heard: [Hello World: 118]
[INFO] [1769816273.351793513] [listener]: I heard: [Hello World: 119]
[INFO] [1769816274.351798046] [listener]: I heard: [Hello World: 120]
[INFO] [1769816275.351782662] [listener]: I heard: [Hello World: 121]
[INFO] [1769816276.351798336] [listener]: I heard: [Hello World: 122]
[INFO] [1769816277.351704815] [listener]: I heard: [Hello World: 123]
```

Figure 1: ROS 2 demo talker and listener nodes exchanging messages.

2.2 rqt_graph Visualization

The `rqt_graph` tool was used to visualize the node and topic relationships between the demo talker and listener nodes.



```
tyagi55@eceprog1:~$ source /opt/ros/humble/setup.bash
rqt_graph
```

```
[1769836082.908666615] [talker]: Publishing: 'Hello World: 359'
```

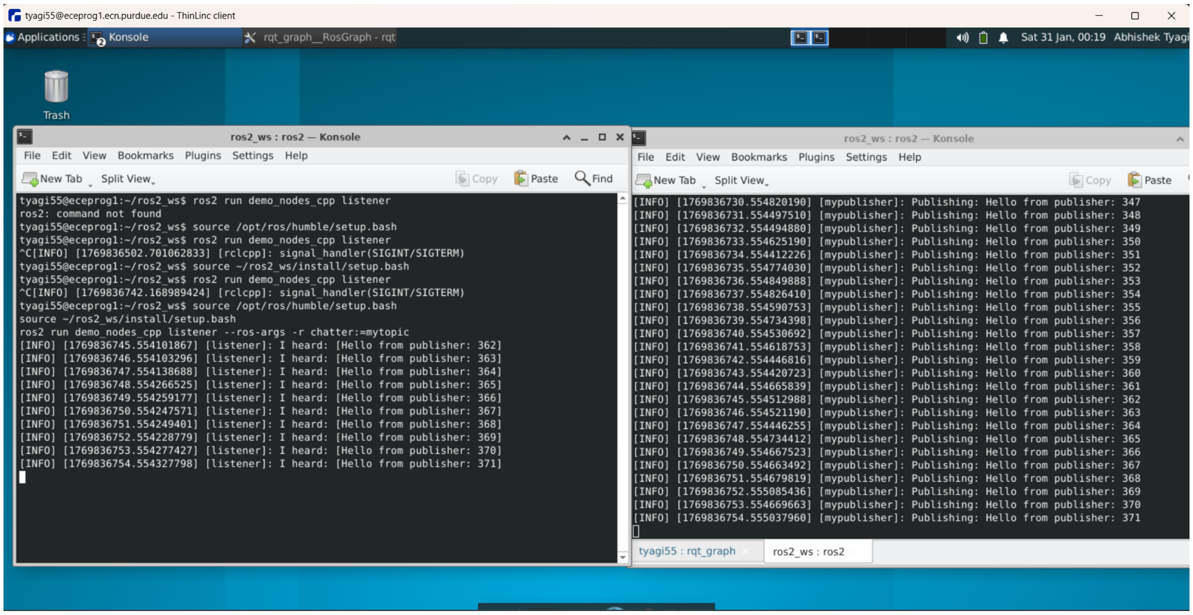
tyagi55@eceprog1.ecn.purdue.edu - ThinLinc client
Applications
Konsole
rqt_graph__RosGraph - rqt
Sat 31 Jan, 00:08 Abhishek Tyagi
tyagi55 : ros2 — Konsole
tyagi55 : rqt_graph — Konsole
File Edit View Bookmarks Plugins Settings Help
New Tab Split View Copy Paste Find
tyagi55 : ros2
tyagi55 : ros2
tyagi55 : ros2
tyagi55 : ros2
tyagi55 : rqt_graph
rqt_graph__RosGraph - rqt
Node Graph
Nodes/Topics (all)
/
/
Group: 2 Namespaces ☑ Actions ☑ tf ☑ Images ☑ Highlight ☑ Fit
Hide: □ Dead sinks □ Leaf topics □ Debug □ tf ☑ Unreachable ☑ Params
/chatter2
/talker
/parameter_events
/rqt_gui_py_node_2979914
/rosout

Figure 2: rqt_graph visualization of the demo talker and listener nodes.

3 Custom Publisher and Subscriber

3.1 Custom Publisher with Demo Listener

A custom Python publisher node was implemented and tested with the ROS 2 demo listener. This verified that custom nodes can interoperate with standard ROS 2 nodes.



```
tyagi55@eceprog1:~/ros2_ws$ ros2 run demo_nodes_cpp listener
ros2: command not found
tyagi55@eceprog1:~/ros2_ws$ source /opt/ros/humble/setup.bash
tyagi55@eceprog1:~/ros2_ws$ ros2 run demo_nodes_cpp listener
^C[INFO] [1769836502.701062833] [rclcpp]: signal_handler(SIGINT/SIGTERM)
tyagi55@eceprog1:~/ros2_ws$ source ~/ros2_ws/install/setup.bash
tyagi55@eceprog1:~/ros2_ws$ ros2 run demo_nodes_cpp listener
^C[INFO] [1769836742.168989424] [rclcpp]: signal_handler(SIGINT/SIGTERM)
tyagi55@eceprog1:~/ros2_ws$ source /opt/ros/humble/setup.bash
source ~/ros2_ws/install/setup.bash
ros2 run demo_nodes_cpp listener --ros-args -r chatter:=mytopic
[INFO] [1769836745.554101867] [listener]: I heard: [Hello from publisher: 362]
[INFO] [1769836746.554103296] [listener]: I heard: [Hello from publisher: 363]
[INFO] [1769836747.554138688] [listener]: I heard: [Hello from publisher: 364]
[INFO] [1769836748.554266525] [listener]: I heard: [Hello from publisher: 365]
[INFO] [1769836749.554259177] [listener]: I heard: [Hello from publisher: 366]
[INFO] [1769836750.554247571] [listener]: I heard: [Hello from publisher: 367]
[INFO] [1769836751.554249401] [listener]: I heard: [Hello from publisher: 368]
[INFO] [1769836752.554228779] [listener]: I heard: [Hello from publisher: 369]
[INFO] [1769836753.554277427] [listener]: I heard: [Hello from publisher: 370]
[INFO] [1769836754.554327798] [listener]: I heard: [Hello from publisher: 371]
```

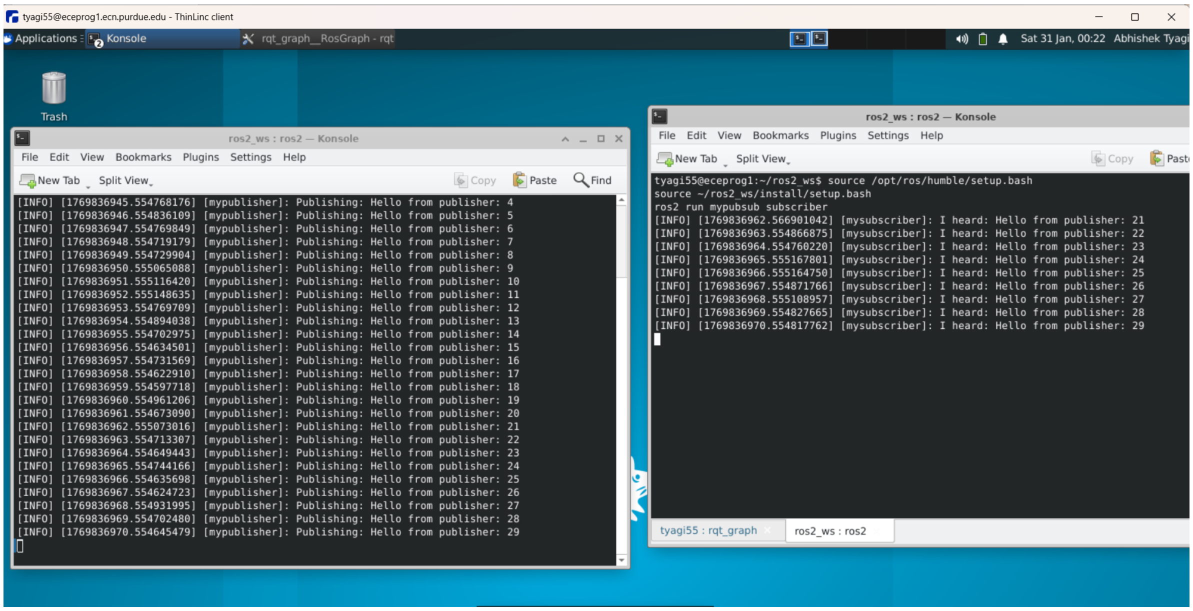
```
[INFO] [1769836730.554820190] [mypublisher]: Publishing: Hello from publisher: 347
[INFO] [1769836731.554497510] [mypublisher]: Publishing: Hello from publisher: 348
[INFO] [1769836732.554494880] [mypublisher]: Publishing: Hello from publisher: 349
[INFO] [1769836733.554625190] [mypublisher]: Publishing: Hello from publisher: 350
[INFO] [1769836734.554412226] [mypublisher]: Publishing: Hello from publisher: 351
[INFO] [1769836735.554774030] [mypublisher]: Publishing: Hello from publisher: 352
[INFO] [1769836736.554849888] [mypublisher]: Publishing: Hello from publisher: 353
[INFO] [1769836737.554826410] [mypublisher]: Publishing: Hello from publisher: 354
[INFO] [1769836738.554590753] [mypublisher]: Publishing: Hello from publisher: 355
[INFO] [1769836739.554734398] [mypublisher]: Publishing: Hello from publisher: 356
[INFO] [1769836740.554530692] [mypublisher]: Publishing: Hello from publisher: 357
[INFO] [1769836741.554618753] [mypublisher]: Publishing: Hello from publisher: 358
[INFO] [1769836742.554446816] [mypublisher]: Publishing: Hello from publisher: 359
[INFO] [1769836743.554420723] [mypublisher]: Publishing: Hello from publisher: 360
[INFO] [1769836744.554665839] [mypublisher]: Publishing: Hello from publisher: 361
[INFO] [1769836745.554512988] [mypublisher]: Publishing: Hello from publisher: 362
[INFO] [1769836746.554521190] [mypublisher]: Publishing: Hello from publisher: 363
[INFO] [1769836747.554446255] [mypublisher]: Publishing: Hello from publisher: 364
[INFO] [1769836748.554734412] [mypublisher]: Publishing: Hello from publisher: 365
[INFO] [1769836749.554667523] [mypublisher]: Publishing: Hello from publisher: 366
[INFO] [1769836750.554663492] [mypublisher]: Publishing: Hello from publisher: 367
[INFO] [1769836751.554679819] [mypublisher]: Publishing: Hello from publisher: 368
[INFO] [1769836752.555085436] [mypublisher]: Publishing: Hello from publisher: 369
[INFO] [1769836753.554669663] [mypublisher]: Publishing: Hello from publisher: 370
[INFO] [1769836754.555037960] [mypublisher]: Publishing: Hello from publisher: 371
```

tyagi55@eceprog1.ecn.purdue.edu - ThinLinc client
Applications
Konsole
rqt_graph__RosGraph - rqt
Sat 31 Jan, 00:19 Abhishek Tyagi
Trash
ros2_ws : ros2 — Konsole
File Edit View Bookmarks Plugins Settings Help
New Tab Split View Copy Paste Find
ros2_ws : ros2 — Konsole
File Edit View Bookmarks Plugins Settings Help
New Tab Split View Copy Paste
tyagi55 : rqt_graph
ros2_ws : ros2

Figure 3: Custom Python publisher communicating with the ROS 2 demo listener node.

3.2 Custom Publisher with Custom Subscriber

A custom subscriber node was developed to receive messages from the custom publisher, demonstrating full user-defined ROS 2 communication.


tyagi55@eceprog1.ecn.purdue.edu - ThinLinc client
Applications
Konsole
rqt_graph__RosGraph - rqt
Sat 31 Jan, 00:22 Abhishek Tyagi
Trash
ros2_ws : ros2 — Konsole
File Edit View Bookmarks Plugins Settings Help
New Tab
Split View
Copy
Paste
Find
ros2_ws : ros2 — Konsole
tyagi55 : rqt_graph
ros2_ws : ros2

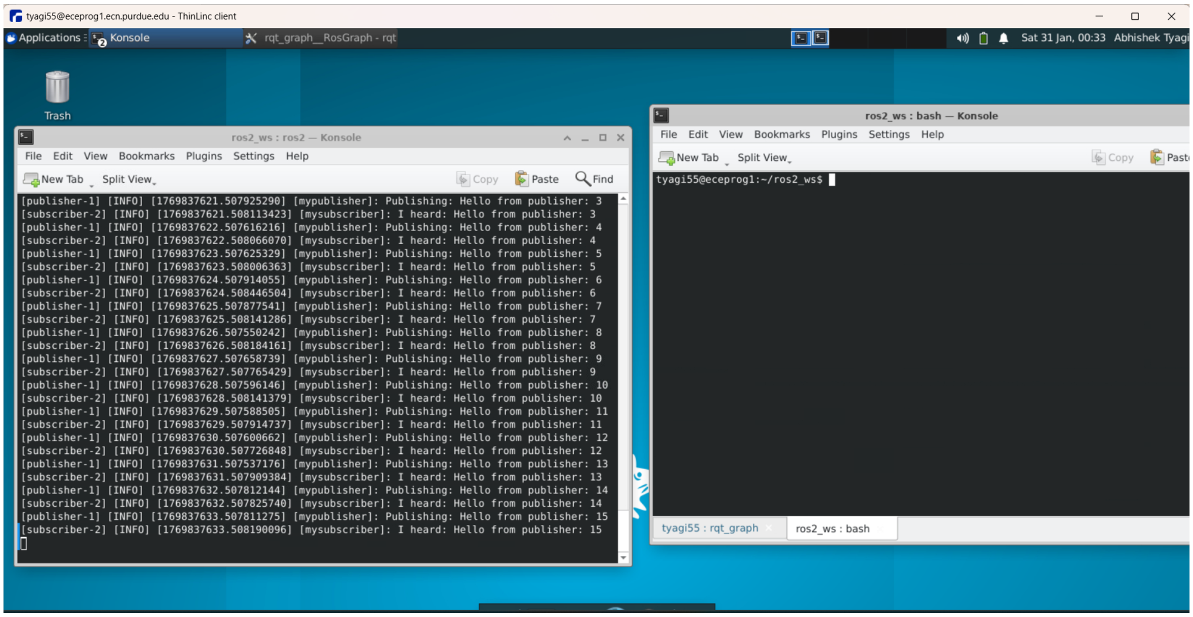
```
[INFO] [1769836945.554768176] [mypublisher]: Publishing: Hello from publisher: 4
[INFO] [1769836946.554836109] [mypublisher]: Publishing: Hello from publisher: 5
[INFO] [1769836947.554769849] [mypublisher]: Publishing: Hello from publisher: 6
[INFO] [1769836948.554719179] [mypublisher]: Publishing: Hello from publisher: 7
[INFO] [1769836949.554729904] [mypublisher]: Publishing: Hello from publisher: 8
[INFO] [1769836950.555065088] [mypublisher]: Publishing: Hello from publisher: 9
[INFO] [1769836951.555116420] [mypublisher]: Publishing: Hello from publisher: 10
[INFO] [1769836952.555148635] [mypublisher]: Publishing: Hello from publisher: 11
[INFO] [1769836953.554769709] [mypublisher]: Publishing: Hello from publisher: 12
[INFO] [1769836954.554894038] [mypublisher]: Publishing: Hello from publisher: 13
[INFO] [1769836955.554702975] [mypublisher]: Publishing: Hello from publisher: 14
[INFO] [1769836956.554634501] [mypublisher]: Publishing: Hello from publisher: 15
[INFO] [1769836957.554731569] [mypublisher]: Publishing: Hello from publisher: 16
[INFO] [1769836958.554622910] [mypublisher]: Publishing: Hello from publisher: 17
[INFO] [1769836959.554597718] [mypublisher]: Publishing: Hello from publisher: 18
[INFO] [1769836960.554961206] [mypublisher]: Publishing: Hello from publisher: 19
[INFO] [1769836961.554673090] [mypublisher]: Publishing: Hello from publisher: 20
[INFO] [1769836962.555073016] [mypublisher]: Publishing: Hello from publisher: 21
[INFO] [1769836963.554713307] [mypublisher]: Publishing: Hello from publisher: 22
[INFO] [1769836964.554649443] [mypublisher]: Publishing: Hello from publisher: 23
[INFO] [1769836965.554744166] [mypublisher]: Publishing: Hello from publisher: 24
[INFO] [1769836966.554635698] [mypublisher]: Publishing: Hello from publisher: 25
[INFO] [1769836967.554624723] [mypublisher]: Publishing: Hello from publisher: 26
[INFO] [1769836968.554931995] [mypublisher]: Publishing: Hello from publisher: 27
[INFO] [1769836969.554702480] [mypublisher]: Publishing: Hello from publisher: 28
[INFO] [1769836970.554645479] [mypublisher]: Publishing: Hello from publisher: 29
```

```
tyagi55@eceprog1:~/ros2_ws$ source /opt/ros/humble/setup.bash
source ~/ros2_ws/install/setup.bash
ros2 run mypubsub subscriber
[INFO] [1769836962.566901042] [mysubscriber]: I heard: Hello from publisher: 21
[INFO] [1769836963.554866875] [mysubscriber]: I heard: Hello from publisher: 22
[INFO] [1769836964.554760220] [mysubscriber]: I heard: Hello from publisher: 23
[INFO] [1769836965.555167801] [mysubscriber]: I heard: Hello from publisher: 24
[INFO] [1769836966.555164750] [mysubscriber]: I heard: Hello from publisher: 25
[INFO] [1769836967.554871766] [mysubscriber]: I heard: Hello from publisher: 26
[INFO] [1769836968.555108957] [mysubscriber]: I heard: Hello from publisher: 27
[INFO] [1769836969.554827665] [mysubscriber]: I heard: Hello from publisher: 28
[INFO] [1769836970.554817762] [mysubscriber]: I heard: Hello from publisher: 29
```

Figure 4: Custom publisher and custom subscriber exchanging messages.

3.3 Launch File Execution

A ROS 2 launch file was created to start both the custom publisher and subscriber nodes simultaneously using a single command.


tyagi55@eceprog1.ecn.purdue.edu - ThinLinc client
Applications
Konsole
rqt_graph__RosGraph - rqt
Sat 31 Jan, 00:33 Abhishek Tyagi
Trash
ros2_ws : ros2 — Konsole
File Edit View Bookmarks Plugins Settings Help
New Tab
Split View
Copy
Paste
Find
ros2_ws : bash — Konsole
tyagi55 : rqt_graph
ros2_ws : bash

```
[publisher-1] [INFO] [1769837621.507925290] [mypublisher]: Publishing: Hello from publisher: 3
[subscriber-2] [INFO] [1769837621.508113423] [mysubscriber]: I heard: Hello from publisher: 3
[publisher-1] [INFO] [1769837622.507616216] [mypublisher]: Publishing: Hello from publisher: 4
[subscriber-2] [INFO] [1769837622.508066070] [mysubscriber]: I heard: Hello from publisher: 4
[publisher-1] [INFO] [1769837623.507625329] [mypublisher]: Publishing: Hello from publisher: 5
[subscriber-2] [INFO] [1769837623.508006363] [mysubscriber]: I heard: Hello from publisher: 5
[publisher-1] [INFO] [1769837624.507914055] [mypublisher]: Publishing: Hello from publisher: 6
[subscriber-2] [INFO] [1769837624.508446504] [mysubscriber]: I heard: Hello from publisher: 6
[publisher-1] [INFO] [1769837625.507877541] [mypublisher]: Publishing: Hello from publisher: 7
[subscriber-2] [INFO] [1769837625.508141286] [mysubscriber]: I heard: Hello from publisher: 7
[publisher-1] [INFO] [1769837626.507550242] [mypublisher]: Publishing: Hello from publisher: 8
[subscriber-2] [INFO] [1769837626.508184161] [mysubscriber]: I heard: Hello from publisher: 8
[publisher-1] [INFO] [1769837627.507658739] [mypublisher]: Publishing: Hello from publisher: 9
[subscriber-2] [INFO] [1769837627.507765429] [mysubscriber]: I heard: Hello from publisher: 9
[publisher-1] [INFO] [1769837628.507596146] [mypublisher]: Publishing: Hello from publisher: 10
[subscriber-2] [INFO] [1769837628.508141379] [mysubscriber]: I heard: Hello from publisher: 10
[publisher-1] [INFO] [1769837629.507588505] [mypublisher]: Publishing: Hello from publisher: 11
[subscriber-2] [INFO] [1769837629.507914737] [mysubscriber]: I heard: Hello from publisher: 11
[publisher-1] [INFO] [1769837630.507600662] [mypublisher]: Publishing: Hello from publisher: 12
[subscriber-2] [INFO] [1769837630.507726848] [mysubscriber]: I heard: Hello from publisher: 12
[publisher-1] [INFO] [1769837631.507537176] [mypublisher]: Publishing: Hello from publisher: 13
[subscriber-2] [INFO] [1769837631.507909384] [mysubscriber]: I heard: Hello from publisher: 13
[publisher-1] [INFO] [1769837632.507812144] [mypublisher]: Publishing: Hello from publisher: 14
[subscriber-2] [INFO] [1769837632.507825740] [mysubscriber]: I heard: Hello from publisher: 14
[publisher-1] [INFO] [1769837633.507811275] [mypublisher]: Publishing: Hello from publisher: 15
[subscriber-2] [INFO] [1769837633.508190096] [mysubscriber]: I heard: Hello from publisher: 15
```

```
tyagi55@eceprog1:~/ros2_ws$
```

Figure 5: Launch file executing both custom publisher and subscriber nodes.

4 Conclusion

This lab demonstrated the ROS 2 publisher–subscriber model using both demo and custom nodes. The use of `rqt_graph` helped visualize node interactions, while launch files simplified multi-node execution. These exercises establish a foundation for more advanced ROS 2 development.