ROS节点通信中发布器publisher和订阅器subscriber模块

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# 创建工作空间

参考<<[胡春旭. 2021-ROS机器人开发实践](https://www.baidu.com/link?url=RqEFkD376cM-ikOjeYZFgrLQSeJcmrX6t3RkwfAL04-k1uLqY67rXqX6tSqqbUCimjhT7e-K0suFbessM-QIoHRYaZGV9vZhAlkAC6haBOe&wd=&eqid=aac40035001a24af0000000462afd9ef" \t "https://www.baidu.com/_blank)>>section3.2部分。

原文链接：https://blog.csdn.net/qq\_24624539/article/details/102755619

安装完成ROS以后会有一个catkin\_ws文件夹，即为ROS工作空间。

[1]创建并初始化一个新的工作空间catkin\_ws

mkdir -p ~/catkin\_ws/src

cd ~/catkin\_ws/src

catkin\_init\_workspace

catkin\_init\_workspace命令把当前目录初始化为一个ROS工作空间。

[2]编译该工作空间。

cd ~/catkin\_ws

catkin\_make

[3]定义catkin\_ws空间所需要的环境变量。执行此命令后，ros的相关命令（如roscd等）可以找到此工作空间中的package。

source ~/catkin\_ws/devel/setup.bash

[4]验证ROS工作空间的环境变量加载成功：

echo $ROS\_PACKAGE\_PATH

[5] create function package

enter the src directory of function package:

catkin\_create\_pkg beginner\_tutorials std\_msgs rospy roscpp

enter the root directory:

catkin\_make

source ./devel/setup.bash

[5]打开环境变量文件sudo gedit .bashrc 加入下面一行：

source ~/catkin\_ws/devel/setup.bash

source ~/.bashrc

[6]最终的环境变量

source /opt/ros/melodic/setup.bash

source ~/catkin\_ws/devel/setup.bash

原文链接：<https://blog.csdn.net/weixin_43297891/article/details/115426161>

# ROS\_work\_space\_package\_node\_topic的关系

ROS中的各个概念解释，工作空间（work space）是ROS中非常重要的一个概念，可以把工作空间理解为一个大的工厂，里面的分成几个大的生产车间（package），每一个生产车间中会有若干个具有不同技能的工人（node）。当工厂运转时，每个车间中的工人node同时工作，他们通过话题（topic）进行信息沟通。各个大的车间之间也存在这互相依赖的关系，共同组成一个有机的整体。

Node是指ROS中运行的最小处理单元。在ROS中，建议为一个目的创建一个节点，设计时注重可重用性。节点运行的同时，向主节点注册节点名称，并且还注册发布者(publisher)/订阅者(subscriber)，服务服务器(service server)/服务客户端(service client), 且注册消息形式，URI地址和端口。每个节点可以使用话题(topic)和服务(service)与其他节点交换消息。发布者(publisher)/订阅者(subscriber)之间传递topic，服务服务器(service server)/服务客户端(service client)之间传递service。

ROS node 之间的通讯形式主要包括两种：topic 和 service。

通过 topic 通讯时，不同的 node 可以向同一个 topic 上发送、接收数据，发送数据的 node 不知道数据是从哪个 node 发送过来的，同样地，发送数据的 node 也不知道是哪个 node 接收了数据。因此，每个 node 都是相对独立的，只需要负责自己的功能实现以及外部接口，不需要关心其他 node 的行为。这是一种开放式的收、发数据的方式，也是 node 之间通讯的主要形式，有利于构造分布式大系统。

service 则是一种请求+反馈的通信机制。消息的传输只涉及两个 node：发送请求的一方称为 client，提供服务的一方叫做 server。在通过 service 形式进行通讯时，client 首先向 server 请求服务, 收到消息之后 server 运行事先设置好的服务功能，并返回消息给 client。service 通讯一般用在事件触发情景中，例如满足某个条件就令 node 开启某项功能，并希望确认功能确实顺利开启。

https://blog.csdn.net/puqian13/article/details/91360102

<https://blog.csdn.net/qq_41972382/article/details/95209741>

# 编写发布器代码

初始化 ROS 系统

在 ROS 网络内广播我们将要在 chatter 话题上发布 [std\_msgs/String](https://link.zhihu.com/?target=http://docs.ros.org/api/std_msgs/html/msg/String.html" \t "https://zhuanlan.zhihu.com/p/_blank) 类型的消息

以每秒 10 次的频率在 chatter 上发布消息

在 beginner\_tutorials package 里创建 src/talker.cpp 文件：

#include <sstream>

#include "ros/ros.h"

#include "std\_msgs/String.h"

int main(int argc, char \*\*argv){

ros::init(argc, argv, "talker");

ros::NodeHandle n;

ros::Publisher chatter\_pub = n.advertise<std\_msgs::String>("chatter", 1000);

ros::Rate loop\_rate(10);

/\* a unique string for each message. \*/

int count = 0;

while (ros::ok()) //ros::ok()

{

std\_msgs::String msg;

std::stringstream ss;

ss << "hello world, I am a genius! " << count;

msg.data = ss.str();

ROS\_INFO("%s", msg.data.c\_str());

chatter\_pub.publish(msg);

ros::spinOnce();

loop\_rate.sleep();

++count;

}

return 0;}

talker.cpp中各行代码意义如下：

#include "ros/ros.h"

//一个实用的头文件，它引用了 ROS 系统中大部分常用的头文件

#include "std\_msgs/String.h"

//引用了 std\_msgs/String 消息, 它存放在 std\_msgs package 里，是由 String.msg 文件自动生成的头文件。

#include <sstream>

/\*\* \* This tutorial demonstrates simple sending of messages over the ROS system. \*/

int main(int argc, char \*\*argv){

/\*\* \* The ros::init() function needs to see argc and argv so that it can perform any ROS arguments and name remapping that were provided at the command line. For programmatic remappings you can use a different version of init() which takes remappings directly, but for most command-line programs, passing argc and argv is the easiest way to do it. The third argument to init() is the name of the node. You must call one of the versions of ros::init() before using any other part of the ROS system. \*/

ros::init(argc, argv, "talker");

//初始化 ROS.可指定节点的名称。节点的名称必须唯一(名称内不能包含 / 等符号)

/\*\* \* NodeHandle is the main access point to communications with the ROS system. \* The first NodeHandle constructed will fully initialize this node, and the last \* NodeHandle destructed will close down the node. \*/

ros::NodeHandle n;

//为这个进程的节点创建一个句柄。

//第一个创建的 NodeHandle 会为节点进行初始化，最后一个销毁的 NodeHandle 则会释放该节点所占用的所有资源 /\*\* \* The advertise() function is how you tell ROS that you want to \* publish on a given topic name. This invokes a call to the ROS master node, which keeps a registry of who is publishing and who \* is subscribing. After this advertise() call is made, the master \* node will notify anyone who is trying to subscribe to this topic name, \* and they will in turn negotiate a peer-to-peer connection with this \* node. advertise() returns a Publisher object which allows you to \* publish messages on that topic through a call to publish(). Once \* all copies of the returned Publisher object are destroyed, the topic \* will be automatically unadvertised. \* \* The second parameter to advertise() is the size of the message queue \* used for publishing messages. If messages are published more quickly \* than we can send them, the number here specifies how many messages to \* buffer up before throwing some away. \*/

ros::Publisher chatter\_pub = n.advertise<std\_msgs::String>("chatter", 1000);

//告诉master 我们将要在 chatter（话题名） 上发布 std\_msgs/String 消息类型的消息。　　　　　　　　　　　　　//如果我们发布的消息的频率太高，缓冲区中的消息在大于 1000 个的时候就会开始丢弃先前发布的消息。

//advertise返回一个 ros::Publisher 对象,它有两个作用： 1) 它有一个 publish() 成员函数可以让你在topic上发布消息； 2) 如果消息类型不对,它会拒绝发布。

ros::Rate loop\_rate(10);

///\*\* \* A count of how many messages we have sent. This is used to create

\* a unique string for each message. \*/

int count = 0;

while (ros::ok())　　　　　　//ros::ok()

{ /\*\* \* This is a message object. You stuff it with data, and then publish it. \*/

std\_msgs::String msg;

std::stringstream ss;

ss << "hello world " << count;

msg.data = ss.str();

ROS\_INFO("%s", msg.data.c\_str());

//ROS\_INFO 和其他类似的函数可以用来代替 printf/cout 等函数。

/\*\* \* The publish() function is how you send messages. The parameter \* is the message object. The type of this object must agree with the type \* given as a template parameter to the advertise<>() call, as was done \* in the constructor above. \*/

chatter\_pub.publish(msg);

//向所有订阅 chatter 话题的节点发送消息。

ros::spinOnce();

//ros::spinOnce()这一语句，否则你的回调函数就永远也不会被调用

loop\_rate.sleep();

//调用 ros::Rate 对象来休眠一段时间以使得发布频率为 10Hz。

++count;

}

return 0;}

# 编辑订阅器代码

订阅器代码流程如下所述：

初始化ROS系统

订阅 chatter 话题

进入自循环，等待消息的到达

当消息到达，调用 chatterCallback() 函数

在 beginner\_tutorials package 目录下创建 src/listener.cpp 文件：

#include "ros/ros.h"

#include "std\_msgs/String.h"

void chatterCallback(const std\_msgs::String::ConstPtr& msg)

//是一个回调函数，当接收到 chatter 话题的时候就会被调用。

{ ROS\_INFO("I heard: [%s]", msg->data.c\_str());

}

int main(int argc, char \*\*argv)

{ ros::init(argc, argv, "listener");

ros::NodeHandle n;

ros::Subscriber sub = n.subscribe("chatter", 1000, chatterCallback);

ros::spin();

return 0;

}

Listener.cpp中各行代码意义如下：

#include "ros/ros.h"

#include "std\_msgs/String.h"

/\* This tutorial demonstrates simple receipt of messages over the ROS system. \*/

void chatterCallback(const std\_msgs::String::ConstPtr& msg)

//是一个回调函数，当接收到 chatter 话题的时候就会被调用。

{ ROS\_INFO("I heard: [%s]", msg->data.c\_str());}

int main(int argc, char \*\*argv)

{ /\*\*

\* The ros::init() function needs to see argc and argv so that it can perform

\* any ROS arguments and name remapping that were provided at the command line. For programmatic

\* remappings you can use a different version of init() which takes remappings

\* directly, but for most command-line programs, passing argc and argv is the easiest

\* way to do it. The third argument to init() is the name of the node.

\* You must call one of the versions of ros::init() before using any other

\* part of the ROS system.

\*/

ros::init(argc, argv, "listener");

/\* NodeHandle is the main access point to communications with the ROS system.

\* The first NodeHandle constructed will fully initialize this node, and the last

\* NodeHandle destructed will close down the node. \*/

ros::NodeHandle n;

/\* The subscribe() call is how you tell ROS that you want to receive messages

\* on a given topic. This invokes a call to the ROS

\* master node, which keeps a registry of who is publishing and who

\* is subscribing. Messages are passed to a callback function, here

\* called chatterCallback. subscribe() returns a Subscriber object that you

\* must hold on to until you want to unsubscribe. When all copies of the Subscriber

\* object go out of scope, this callback will automatically be unsubscribed from

\* this topic. \*

\* The second parameter to the subscribe() function is the size of the message

\* queue. If messages are arriving faster than they are being processed, this

\* is the number of messages that will be buffered up before beginning to throw

\* away the oldest ones.

\*/

ros::Subscriber sub = n.subscribe("chatter", 1000, chatterCallback);

//告诉 master 我们要订阅 chatter 话题上的消息。当有消息发布到这个话题时，ROS 就会调用 chatterCallback() 函数。第二个参数是队列大小，以防我们处理消息的速度不够快，当缓存达到 1000 条消息后，再有新的消息到来就将开始丢弃先前接收的消息。

/\*\* \* ros::spin() will enter a loop, pumping callbacks. With this version, all \* callbacks will be called from within this thread (the main one). ros::spin() \* will exit when Ctrl-C is pressed, or the node is shutdown by the master. \*/

ros::spin();

//ros::spin() 进入自循环，可以尽可能快的调用消息回调函数。

return 0; }

# [CMakeLists\_txt](https://link.zhihu.com/?target=http://wiki.ros.org/catkin/CMakeLists.txt" \t "https://zhuanlan.zhihu.com/p/_blank)文件

## 确认原始[CMakeLists.txt](https://link.zhihu.com/?target=http://wiki.ros.org/catkin/CMakeLists.txt" \t "https://zhuanlan.zhihu.com/p/_blank)文件

原始文件中保留的有用代码如下：

cmake\_minimum\_required(VERSION 2.8.3)

project(beginner\_tutorials)

## Find catkin and any catkin packages

find\_package(catkin REQUIRED COMPONENTS

roscpp

rospy

std\_msgs

genmsg)

catkin\_package()

## 在 [CMakeLists.txt](https://link.zhihu.com/?target=http://wiki.ros.org/catkin/CMakeLists.txt" \t "https://zhuanlan.zhihu.com/p/_blank) 文件末尾加入几条语句:

include\_directories(include ${catkin\_INCLUDE\_DIRS})

add\_executable(talker src/talker.cpp)

target\_link\_libraries(talker ${catkin\_LIBRARIES})

add\_dependencies(talker ${PROJECT\_NAME}\_generate\_messages\_cpp)

add\_executable(listener src/listener.cpp)

target\_link\_libraries(listener ${catkin\_LIBRARIES})

add\_dependencies(listener ${PROJECT\_NAME}\_generate\_messages\_cpp)

## 说明

1-2会生成两个可执行文件, talker 和 listener, 默认存储到 [devel space](https://link.zhihu.com/?target=http://wiki.ros.org/catkin/workspaces%23Development_.28Devel.29_Space" \t "https://zhuanlan.zhihu.com/p/_blank) 目录下,具体在~/catkin\_ws/devel/lib/<package name> 中.

3.如果在 \*Groovy\* 版本下，你可以使用下边的这个变量来添加对所有必须的文件依赖:

add\_dependencies(talker ${catkin\_EXPORTED\_TARGETS})

# 编译及运行流程

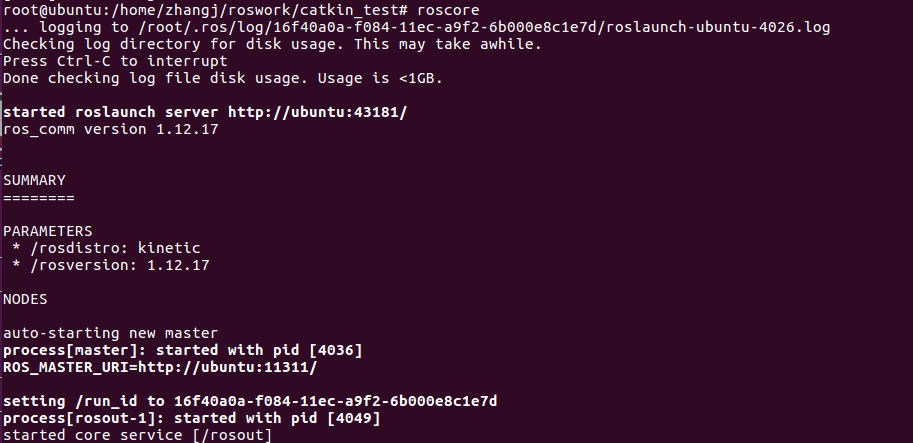
## 进入catkin\_test项目文件夹的根目录；

1. source ./devel/setup.bash

## 输入catkin\_make命令，编译源码；

## 设置环境变量： source ./devel/setup.bash

## 启动ROS Master：roscore

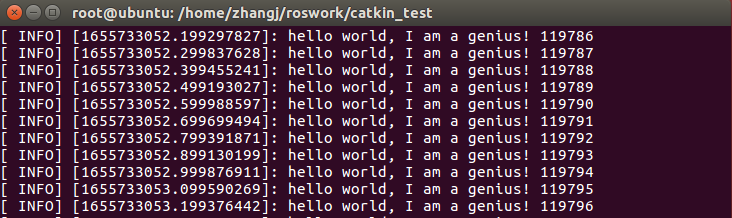


## 启动Publisher: rosrun learning\_communication talker

## In the “catkin\_ws” directory:

## source ./devel/setup.bash

rosrun beginner\_tutorials talker

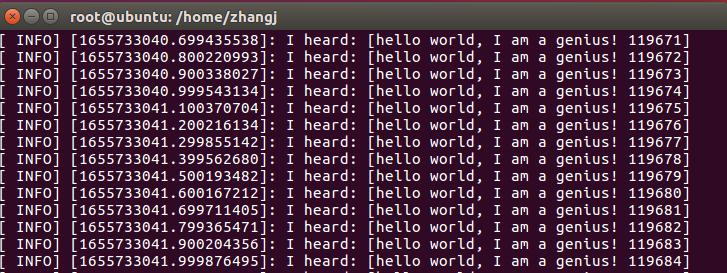


## 启动Subscriber：rosrun learning\_communication listener

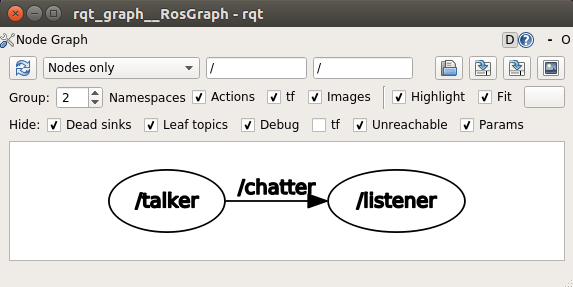
## Create a new termial

## source ./devel/setup.bash

## rosrun beginner\_tutorials listener



## 查看例程的节点关系: rqt\_graph



# 出现问题及解决

## [rospack] Error: package 'learning\_communication' not found

## 在最后运行时，出现error: package ‘\*\*\*’ not found错误

## 解决方法：source devel/setup.bash

# 参考文献

1. <https://zhuanlan.zhihu.com/p/452758643>
2. [胡春旭. 2021-ROS机器人开发实践](https://www.baidu.com/link?url=RqEFkD376cM-ikOjeYZFgrLQSeJcmrX6t3RkwfAL04-k1uLqY67rXqX6tSqqbUCimjhT7e-K0suFbessM-QIoHRYaZGV9vZhAlkAC6haBOe&wd=&eqid=aac40035001a24af0000000462afd9ef" \t "https://www.baidu.com/_blank). section3.6:话题中的Publisherr与Subscriber.