

# Distributed Autoware #2551

Unanswered crazydude123 asked this question in Q&A



**crazydude123** on Apr 22, 2022

Hi,

I have a usecase where two cameras, LiDAR, and a GPU are setup on the street light posts of the road.

I want to deploy the Euclidean\_clustering algorithm of Autoware on the light post, and send the resultant to the cloud for decision algorithms (Autoware again).

1. Is this feasible?
2. Does Autoware have command-line support? i.e. scp'ing the rosbag (2 images, lidar topics) to the Euclidean\_clustering deployment, then scp'ing the output (bounding boxes) to cloud?

↑ 1

Category

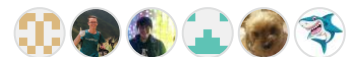


Q&A

Labels

None yet

6 participants



2 comments · 14 replies

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**kenji-miyake** on Apr 22, 2022

@crazydude123

Is this feasible?

I guess you can do it if set up your launch files.

i.e. scp'ing the rosbag (2 images, lidar topics) to the Euclidean\_clustering deployment, then scp'ing the output (bounding boxes) to cloud?

Could you explain this workflow more in detail?

Did you mean like this?

- You have a rosbag file.
- You send the rosbag to the Euclidean\_clustering ECU by `scp`.
- The ECU automatically processes the rosbag and send the result to the cloud?

↑ 1

9 replies



**crazydude123** on Apr 25, 2022 Author

@kenji-miyake, here's the use-case in detail:

We want to make buses autonomous. So parts of Autoware AD are deployed on a nearby light-post and parts of it are deployed on the main 5G router. I want to experimentally figure out which parts need to be deployed where. The GPU at the lightpost isn't as powerful as the one at the 5G router, and so the process needs to be experimental. We have 20 such lightposts, and can thus get a global image of the live-traffic at any point in time.

Going by @Sharrrrk's answer, I guess I need to wait for the AD API. Distributing ros2 nodes across servers is something I would love to try.



**kenji-miyake** on Apr 25, 2022

What are "Ros2 nodes"? Are these separate "local servers" that run when I launch autoware?

It's good to read this document first.

<https://docs.ros.org/en/rolling/Tutorials/Understanding-ROS2-Nodes.html>

The tutorial you linked on Launch files does not talk about deploying different "ros2 nodes" on different devices/servers (across the internet). Is this possible? Can this be done in one single launch file? Any links for more info?

ROS 2 Docs site is a good start.

<https://docs.ros.org/en/rolling/Tutorials.html>



**Sharrrrk** on Apr 26, 2022 Maintainer

@crazydude123 Deploying different "ros2 nodes" on different devices/servers cannot be achieved by a single launch file, you need at least one launch file for each hardware. The easy way is to use local network or VPN, then ROS2 nodes can automatically communicate with each other.



**crazydude123** on Apr 26, 2022 Author

Thanks again for your reply!

Any examples online of this specific case where ros2 nodes are spun up across servers?



**Sharrrrk** on Apr 27, 2022 Maintainer

Yes, you can refer to the following two examples:

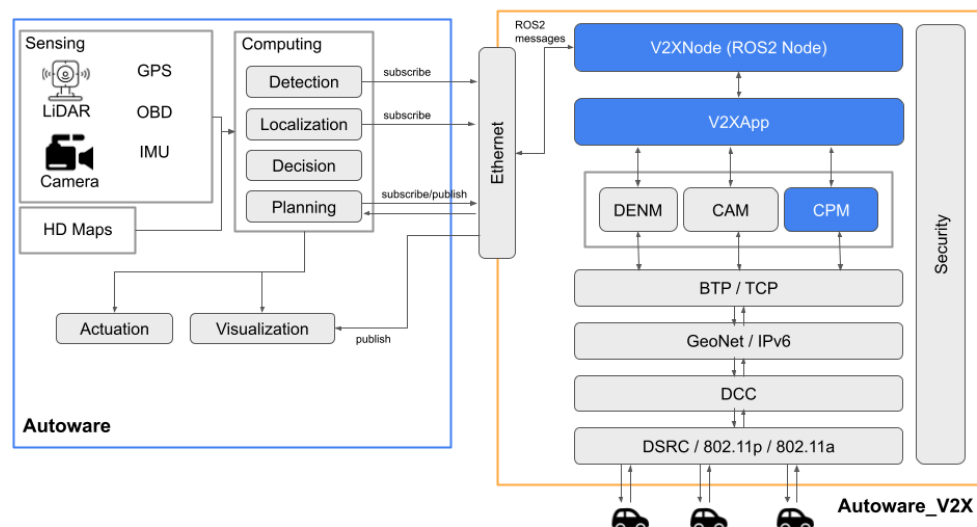
[https://github.com/Adlink-ROS/adlink\\_ddsbot](https://github.com/Adlink-ROS/adlink_ddsbot)

[https://github.com/Adlink-ROS/adlink\\_neuronbot](https://github.com/Adlink-ROS/adlink_neuronbot)

yuasabe on Apr 27, 2022

Collaborator

As part of ongoing research, I am currently working on adding Vehicle-to-Everything (V2X) communication capabilities to Autoware. The implementation is still not open-sourced, but the overall architecture is as shown in the diagram below. We have utilized the open-source V2X software stack called [Vanetza](#), and have integrated it with Autoware.



This will allow Autoware to send information to other Autoware-enabled vehicles/infrastructure through a variety of access mediums, such as Wi-Fi, LTE/5G, etc. So, in your case, I understand that the light posts have a cellular connection to the cloud, so by defining a set of messages to use over the air, any sort of information can be sent from the Autoware used in the light posts to the Autoware used in the cloud.

We are currently in the later stages of evaluating performance metrics of our implementation, and after that, we should be able to make the code public. I believe that use cases like yours are very interesting, and I will be more than happy to cooperate together hopefully in the near future.



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5 replies

Croquembouche on Aug 8, 2022

Collaborator

Hi,

I just joined the Autoware foundation. We will be building a simulation environment that does the above. The entire simulation will be in CARLA.



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Croquembouche on Aug 8, 2022

Collaborator

Most of the simulation is done. I just need to integrated into AWF.

evshary on Apr 20, 2023

Collaborator

**@yuasabe** May I ask some questions about your architecture? I'm not really familiar with V2X and I hope to understand more.

1. Is Autoware and Autoware\_V2X running in different hosts? If so, is there any reason why running on different hosts? Is it because of safety?
2. Are the blue parts what you developed? (V2XNode, V2XApp, CPM) Does V2XApp use TCP/IP network stack directly? (That means Open socket and send messages) I'm really interested in how V2XApp interacts with the lower layer stack.
3. We're studying whether Zenoh (another protocol similar to DDS, but has more benefits) can be used in the V2X scenario. Do you think this kind of distributed network protocol can be used in V2XApp?

We are looking forward to your implementation. We're happy to hear any news from you or if you're interested in cooperation together.



**yuasabe** on Apr 20, 2023 Collaborator

**@evshary** Thank you for the questions.

1. Autoware and AutowareV2X do not necessarily have to be run on different hosts. As long as they are in the same network and ROS 2 messages can be exchanged between them, Autoware and AutowareV2X can be placed in either the same host or separate hosts. By enabling AutowareV2X to be put on a separate host, I believe that (i) it can be easily integrated into existing Autoware-powered systems, (ii) it can act as a gateway router that can provide network connectivity to other applications (i.e., infotainment), and (iii) it can be isolated from safety-critical processes on the main Autoware ECU (as you pointed out).
2. The blue parts are the main components that were developed. For the network stack, we have focused on the ETSI C-ITS protocol suite, where the lower layers are mainly provided by [Vanetza](#). Cooperative ITS protocols such as GeoNetworking, Basic Transport Protocol, Decentralized Congestion Control, etc. that are standardized by ETSI are used in place of the widely used TCP/IP stack. Lower-level processes such as opening/closing of sockets and serialization of messages are mainly done via Vanetza.

3. I'm actually very interested in Zenoh, and have seen [🗨️ Run multiple Autoware in Carla with Zenoh #3434](#), [🗨️ How to use Zenoh in Autoware #2968](#). I understand how this can enable the use of multiple Autoware instances in simulator-based environments, and how Zenoh can help DDS hop over routers. However, I'm still not sure how this can be used in the context of wireless V2X communication between multiple vehicles or infrastructure. In the design of AutowareV2X, the ROS 2 environment stays in the local Autoware-based system, and the messages in Autoware are converted into packets that are sent over various wireless mediums to reach other vehicles or infrastructure. What protocol to use for the packets is an important point of discussion, but for the sake of the first implementation, I have focused on using the European ETSI standards. I still don't know much about Zenoh, however, so I would love to study some more and see in what ways we can collaborate!



**evshary** on Apr 21, 2023 Collaborator

[@yuasabe](#) Thanks for your detailed answers. I'll take a look at Vanetza and see whether there is a possibility to integrate with Zenoh. Welcome to any further discussion if you think we can collaborate. Also, expect the release of your awesome implementation!