96Boards - Autoware: 1 year on

Servando German

<servando.german.serrano@linaro.org>
Introduction

Servando German Serrano
Software Applications Engineer, Linaro - 96Boards
Autonomous systems engineer with experience working in different domains: air, underwater and ground based platforms. Past experience involves working at Ixion Industry & Aerospace, a highly innovative SME in Spain, Airbus Defence and Space, in Stevenage, and most recently at Transport Systems Catapult, based in Milton Keynes.
One year ago - BKK19

**Autoware Introduction**

Theodore Grey  
<theodore.grey@linaro.org>

Servando German  
<servando.german.serrano@linaro.org>

**Autoware Improvements**

Theodore Grey  
<theodore.grey@linaro.org>

Servando German  
<servando.german.serrano@linaro.org>
BKK19 - Autoware Introduction

Autoware
BKK19 - Autoware Improvements

- Unit testing
  - Autoware.AI code base has a very limited set of unit tests.
  - A testing framework has been proposed and is being implemented by Linaro and Autoware contributors.
  - Features in new PRs are being submitted with unit tests.
Continuous Integration

- Pipeline failures occurred due to the addition of unit tests happening in Travis CI.
- Transition from Travis CI to Gitlab CI infrastructure:
  - Unit tests run on push to repo branches and PRs.
  - Code coverage reports also generated through the Gitlab CI infrastructure using LCOV and publicly available as Gitlab pages.
- Drawbacks of Gitlab CI:
  - No automatic trigger of CI pipelines on PRs from project forks (when integrated with Github).
  - Only x86 runners.
  - No secret variables, hence not possible to push docker images directly to Dockerhub without credentials compromise.
- Evaluation of Linaro CI based in Jenkins to support arm64 native builds or Linaro’s arm64 Gitlab runners.
BKK19 - Autoware Improvements

- Autoware Demo documentation improvements:
  - Updated Autoware release version to be used.
  - Addition of clear steps to follow.
  - Addition of screenshots reflecting the steps for easier replication.
Autoware.IO - 96Boards Automotive

- An interface project for Autoware to be extended with proprietary software and third-party libraries in a reliable manner.
- Examples include device drivers for sensors, by-wire controllers for vehicles, and hardware-dependent programs for SoC boards.
- Autoware.IO provides a heterogeneous hardware reference platform with tools, unified interface design and test framework.
- Autoware.IO enables the integration of member company's solutions onto platforms which support the Autoware.Auto and Autoware.AI software stack.
Autoware.IO - AutoCore PCU

- ROS Discourse Announcement: https://discourse.ros.org/t/open-source-and-free-software-for-autocores-pcu/12418
- Reference hardware design.
- MCU-MPU architecture.
- Additional hardware accelerator could be connected via PCIe with additional computing power.
96Boards - Autoware.IO | Multi SOC support
Board preparation:
- Started flashing the board using the Bionic Builder Tool.
- Ubuntu 18.04 with kernel v4.9.78

Update bootloader to enable PCIE power on the board.

Upgrade kernel to v4.14.78 for preempt RT patching.
- Cross-compile patched kernel
- Flash built kernel

Verify successful flashing via `uname -v`:
```bash
... SMP PREEMPT RT ...```

---

**96Boards - Real time and ROS2 | Hikey970**
96Boards - Real time and ROS2 | Hikey970

- Installed ROS2 Dashing
  - Hard RT not yet achievable
  - Initial support available

- Inverted pendulum demo
  - By default, 8Gb RAM required
  - Needed to modify source to fit in the 6Gb RAM available in the Hikey970

- Run FastRTPS and Cyclone DDS
96Boards - Real time and ROS2 | Hikey970

- Demo requirements
  - 1 KHz (1 ms) update loop
  - Maximum jitter allowance 3% (30000 ns)
Board preparation:
- Flash default Linaro Debian Buster as per documentation on 96boards.org

Upgrade kernel to v5.2 from Linaro’s Qualcomm landing team
- Download kernel tree
- Patch preempt rt
- Cross-compile patched kernel
- Flash built kernel

Verify successful flashing via `uname -v`:
... SMP PREEMPT RT ...
Since Debian Buster is not supported by ROS2 we installed Docker.
96Boards - Real time and ROS2 | Db845c

- Pull `96boards/ros:dashing`
- Inverted pendulum demo
  - By default, 8Gb RAM required
  - Needed to modify source to fit in the 4Gb RAM available in the Dragonboard-845c
- Setup memory locking permissions for the docker container
- Run FastRTPS and Cyclone DDS
Demo requirements
- 1 KHz (1 ms) update loop
- Maximum jitter allowance 3% (30000 ns)
96Boards - Autoware everywhere

- New blog series.
- Preparation effort for Heterogeneous platform from Autoware.IO.
- Deploy Autoware on different 96Boards SoCs.
  - From source or docker options
  - Autoware.AI: subset of components due to hardware constraints.
  - Autoware.Auto.
  - Bridge .AI and .Auto.
96Boards - Autoware everywhere | .AI

- Detailed steps outlined in [this blog post](#).
- To test .AI we run a subset of the Rosbag demo.
- To run headless some Autoware parameters need to be loaded manually.
- Due to memory constraints, just mapping, sensing and localization can be run alongside on Hikey 970.
96Boards - Autoware everywhere | .AI
96Boards - Autoware everywhere | .Auto

- Detailed steps outlined in [this blog post](#).
- Docker image available for testing purposes in [96Boards/autoware Dockerhub repo](#).
To test .Auto we run the 3D Perception Stack demo:

- Adapted steps for headless run.
- Visualization on separate laptop.
- Board and laptop connected via Ethernet.
- Demo data downloaded in the board to avoid comms delay.
96Boards - Autoware everywhere | .Auto
96Boards - Autoware everywhere | Bridge

- Detailed steps outlined in [this blog post](#).
- Use ros1_bridge to connect ROS1 and ROS2 distributions.
- Link default ROS msgs in Autoware.AI and .Auto.
- Bridge both software stacks together so we can use the improved software of .Auto but still run functionalities of .AI that have not been ported yet.
- Tested bridge functionality by using Velodyne driver from .Auto along with the NDT mapping algorithm from .AI.
- For convenience, Docker image for ros1_bridge available in [96boards/ros Dockerhub repo](#).
96Boards - Autoware everywhere | Bridge
Thank you

Join Linaro to accelerate deployment of your Arm-based solutions through collaboration

contact@linaro.org