ROSCon 2024 - A Journey to Becoming a First-Class RMW Alternative

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About me

- Mathias Kraus
- elBoberido on github
- core iceoryx maintainer since ~7 years
- prior to that, 10 years in measurement and automation industry
  - working on embedded devices and FPGAs

About ekxide

- founded by 2 core iceoryx maintainer (Christian Eltzschig and me)
  - classical bootstrap and 100% owned by the founders
- offers commercial support, feature development and consulting for iceoryx
- >95% of contributions to iceoryx from ekxide employees

What is iceoryx

- true zero-copy inter-process communication
- consistently ultra-low latency
- virtually limitless bandwidth
- supports multiple messaging pattern
- runs on multiple OSes
- designed for mission-critical systems

iceoryx and ROS

- open-sourced in 2019 to present the rmw_iceoryx at the ROSCon in Macau
  - Michael Pöhnl and Karsten Knese created the initial RMW implementation

- integrated into Cyclone DDS
  - available to ROS users by rmw_cyclonedds
  - hidden behind a runtime flag

Challenges for robotics and autonomuous systems

The amount of data to be processed is constantly increasing

- high resolution cameras
- lidar
- copying data becomes a bottleneck

Safety certification

- companies are starting with ROS
  - great ecosystem, tooling & large talent pool
  - fast path to a working product
- often a full rewrite is done for production
  - due to strict constraints by regulatory bodies
  - results in high costs and delays

Limitations and pain points of iceoryx

- requires a central daemon
- static resource management
  - memory pools
  - endpoints like publisher & subscriber
- limited network-transparency
- hard to safety certify due to some early design decisions
  - shared memory pools
  - shared access to endpoints
- monolithic design makes development of custom extensions difficult

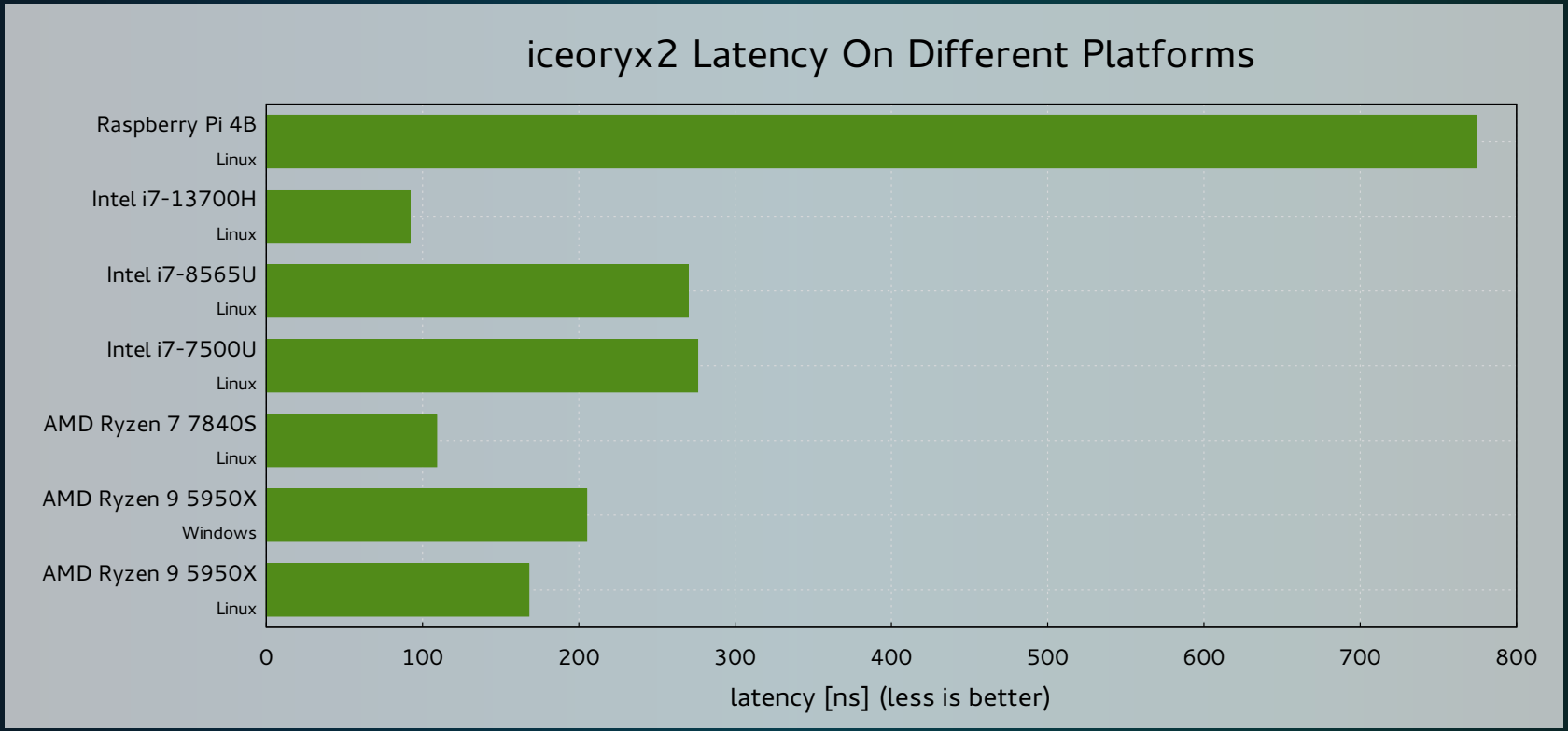
Lessongs learned

-> let's start from scratch

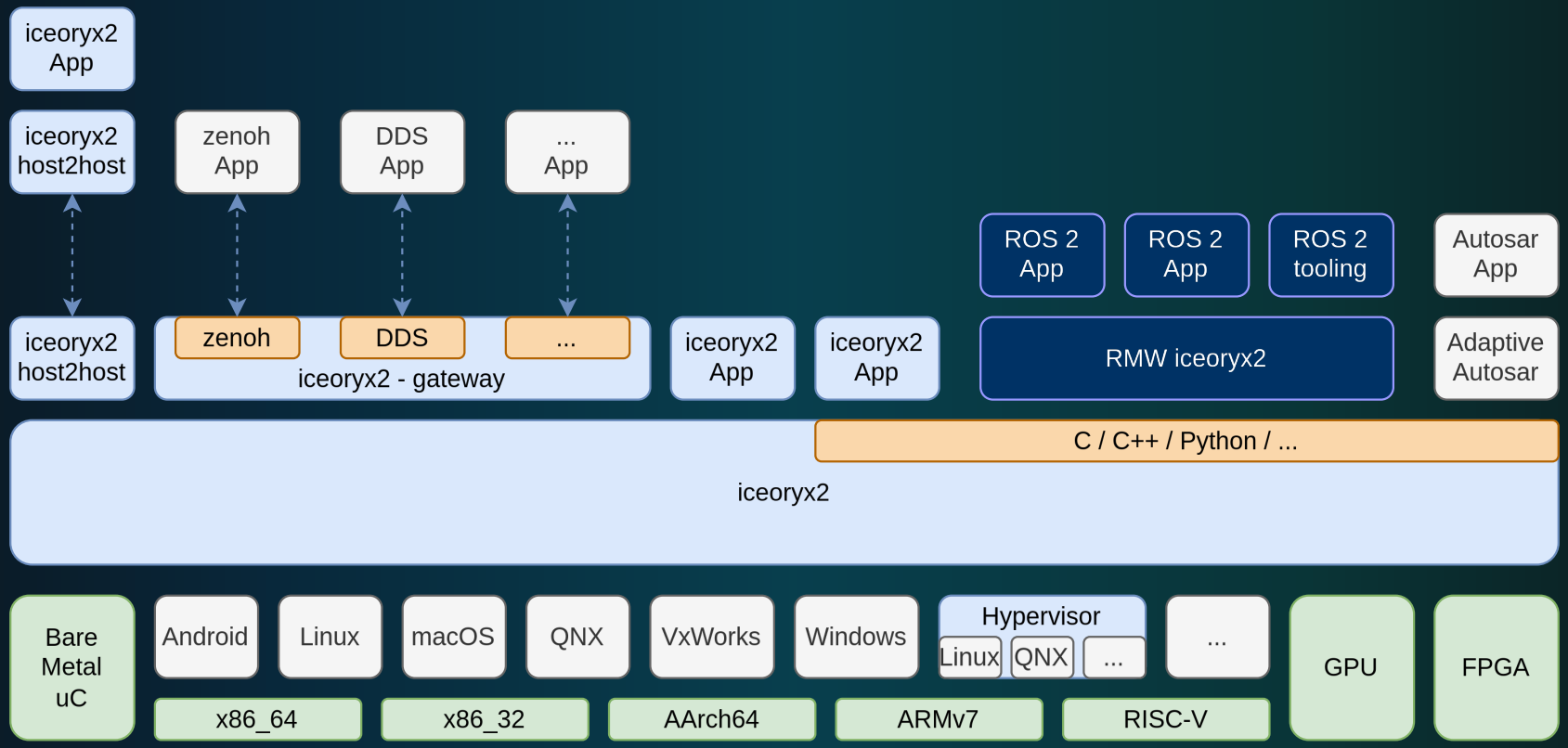
Meet iceoryx2

- written in Rust
  - extremely helpful to get the hard parts right
  - re-use the good parts of iceory1 by porting to Rust
- C and C++ bindings
  - Python and other language bindings planned
- no central daemon
- fine grained resource management
  - e.g. memory pool is tied to the respective endpoint
- modular design to easily replace single components and add custom extensions
- better usability and performance
  - ~100ns latency on a modern developer machine

iceoryx2 benchmarks



iceoryx2 vision



Integration with ROS 2

- use zero-copy compatible ROS 2 Messages
  - best performance
  - https://github.com/ZhenshengLee/ros2_shm_msgs
  - maintained by Zhensheng (Victor) Lee
- Standard ROS Messages are serialized
  - moonshot: Standard ROS Messages with zero-copy
- network communication via gateways
  - any network protocol can be used for gateways
  - any volunteers for an IP over Avian Carrier gateway?
- rmw_iceoryx2 becomes a first-class RMW alternative
  - opens a path for ROS 2 in a safety environment

Running in a safety environment

- network stacks are usually not safety certified
  - needs to run in a separate QM process
  - connected via iceoryx2
- Option 1: ROS 2 for safety applications
  - iceoryx2 as communication middleware
  - requires safety certified ROS 2
- Option 2: iceoryx2 for safety applications
  - ROS 2 for QM applications
  - seamless communication between iceoryx2 and ROS 2
  - only a subset needs to be ported to native iceoryx2 API
    - clean migration path
    - one application at a time
    - everything keeps running

Current state of rmw_iceoryx2 and outlook

- https://github.com/ekxide/rmw_iceoryx2
  - will be made public soon™
  - in active development
  - initial release (tech preview) with pub-sub and waitset
  - kudos to Jeff Ithier who drives the development
- utilize the iceoryx2 strengths for ROS 2
  - minimize intra-host latency
  - network communication decoupled and hot-swappable

Get in touch with us to speed up rmw_iceoryx2 development and help us to accelerate your product.

That's all folks

Should I put a space between iceoryx and 2?
No!

More questions?