Embedded
Online
Conference

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Embedded Development with Qt: Exploring Use Cases Beyond MCUs and MPUs

Exploring Use Cases Beyond MCUs and MPUs

Veli-Pekka Heinonen

THE SPEAKER

Veli-Pekka Heinonen

Senior Product Manager, The Qt Group

Focus: Embedded software development

Veli-Pekka Heinonen is currently Senior Product Manager at The Qt Company, responsible for embedded platforms, WebAssembly, multimedia and related Cloud projects. He has over 20 years of experience in the IT and hardware industries, and he has been working in various product management and product marketing roles. Before joining Qt, his last position was at Cisco, working with customer projects, support, and security for a communications client.

Veli-Pekka holds a master's degree in software engineering from Helsinki University of Technology (now known as Aalto University).

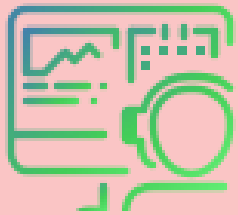
AGENDA

1. Traditional Qt Use Cases
2. Qt for WebAssembly
3. Qt in the Cloud
4. Qt Angle to Digital Twins
5. Key Takeaways

Traditional Qt Use Case

Leverage full Qt offering to your benefit – design, develop, test, deploy, also for a portfolio of products across MCU and MPU.

Challenges in Creating Digital Experiences



Getting great software developers is hard

Building a portfolio of devices is expensive

UI designers, developers and QA work in silos

Agile Software Development

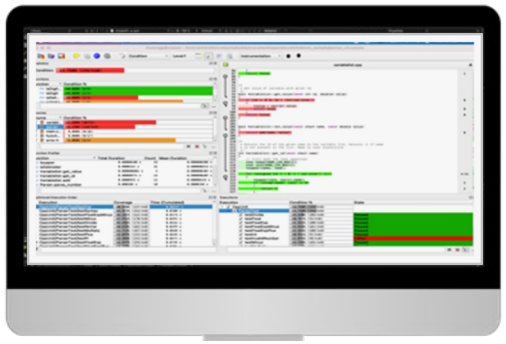
UI Design

2D / 3D UI Design Tools

UI Composition

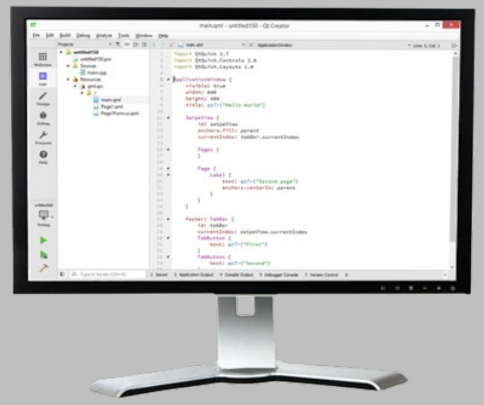
Qt Design Studio

Test



Qt Squish, Qt Coco

Develop



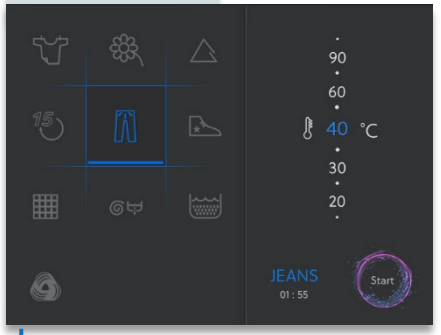
Qt Creator IDE

SINGLE CODEBASE

Cross product-line development

Retain a unified look & feel for your pixel-perfect UIs across an entire range of products, using the same core technology, and without increasing TTM or TCO.

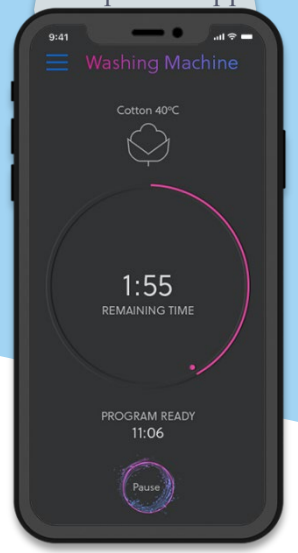
Low-end



- ✓ Qt for MCUs
- ✓ Smartphone-like UX
- ✓ Basic animations
- ✓ Bare metal or freeRTOS

Cortex-M4 MCU (<10 EUR BOM) – 640x480

Companion app



- ✓ Complex/ simple apps
- ✓ Win, Mac, Linux, Android, iOS
- ✓ WEBASM

Mid-range

- ✓ Higher resolution
- ✓ 2.5D Graphics
- ✓ Full Qt Framework
- ✓ Advanced animations
- ✓ Linux or RTOS

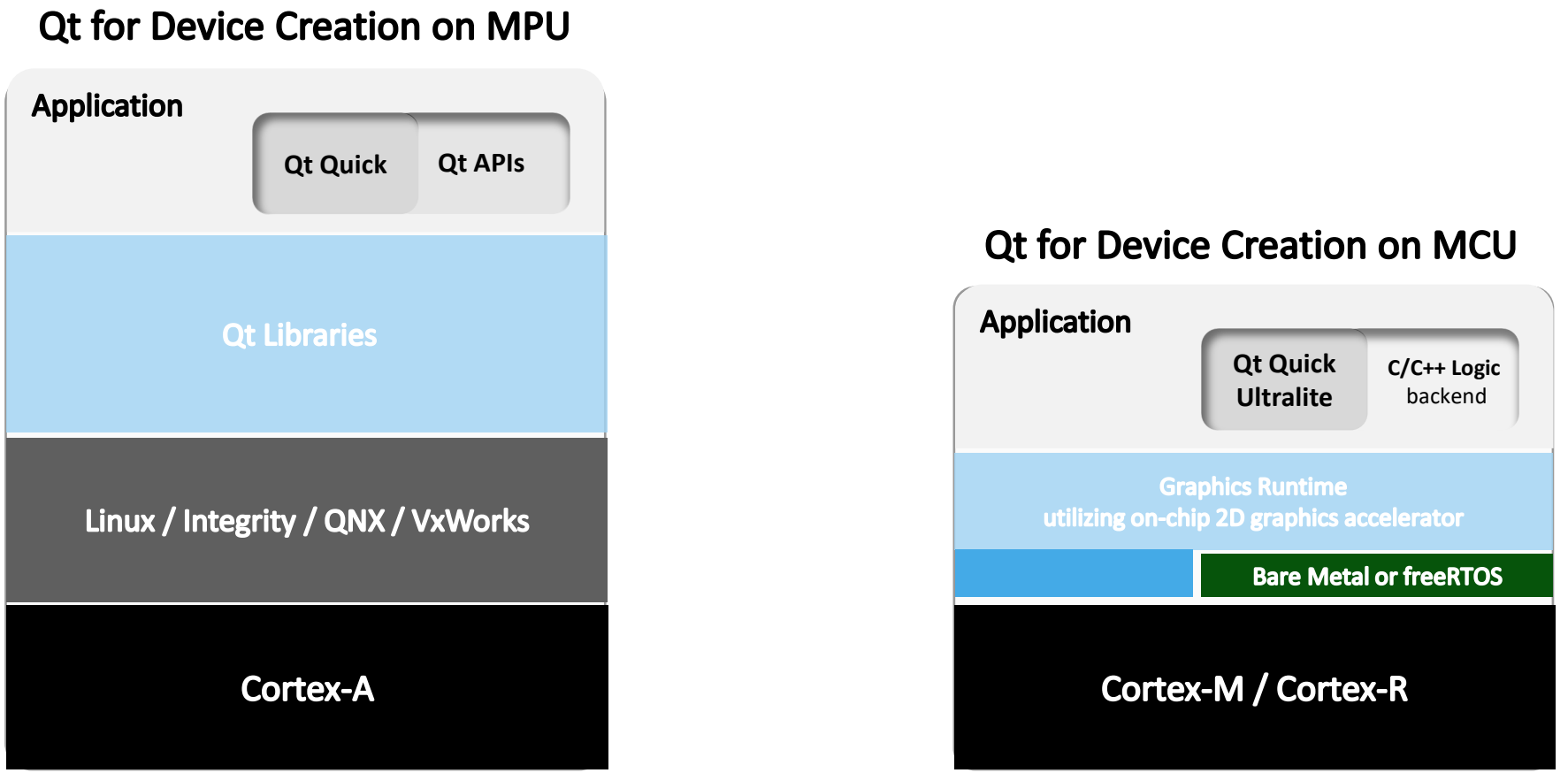
ARMv7A 32bit low end MPU (<30 EUR BOM) – 854x480

High-end

- ✓ Highest resolution
- ✓ Dual screen support
- ✓ 2D/3D Graphics
- ✓ Full Qt Framework
- ✓ Linux or RTOS

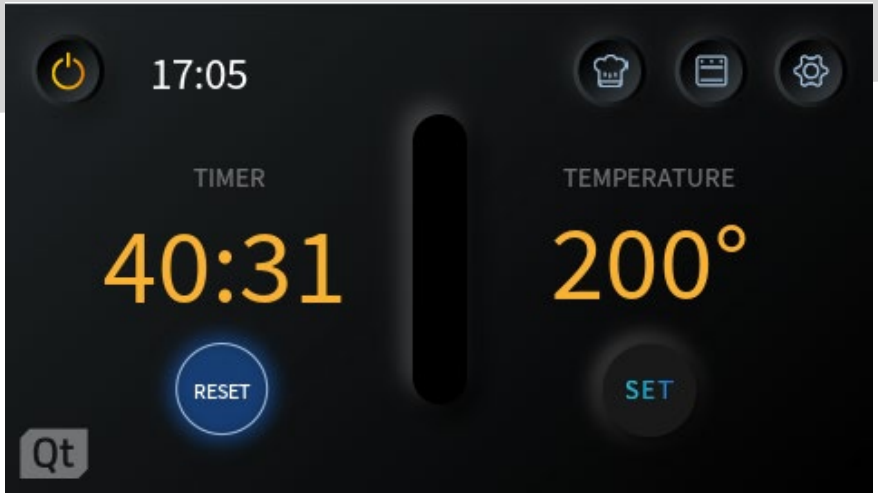
ARM-v8A 64bit Quad Core high end MPU (<100 EUR BOM) – 960x480

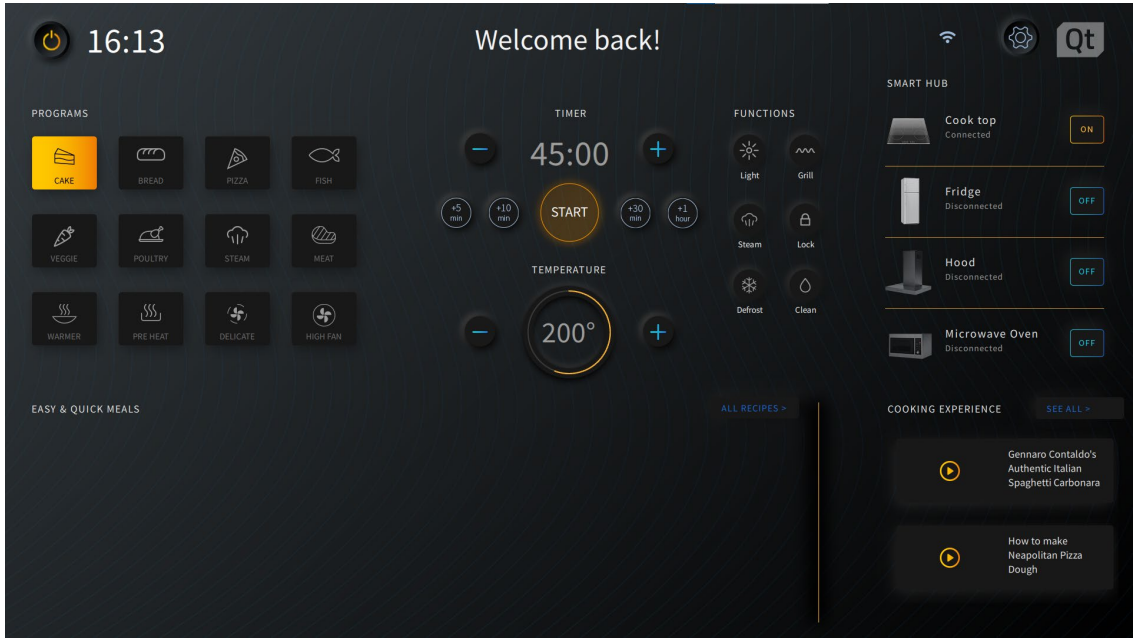
A New Endeavor to Address Scalability



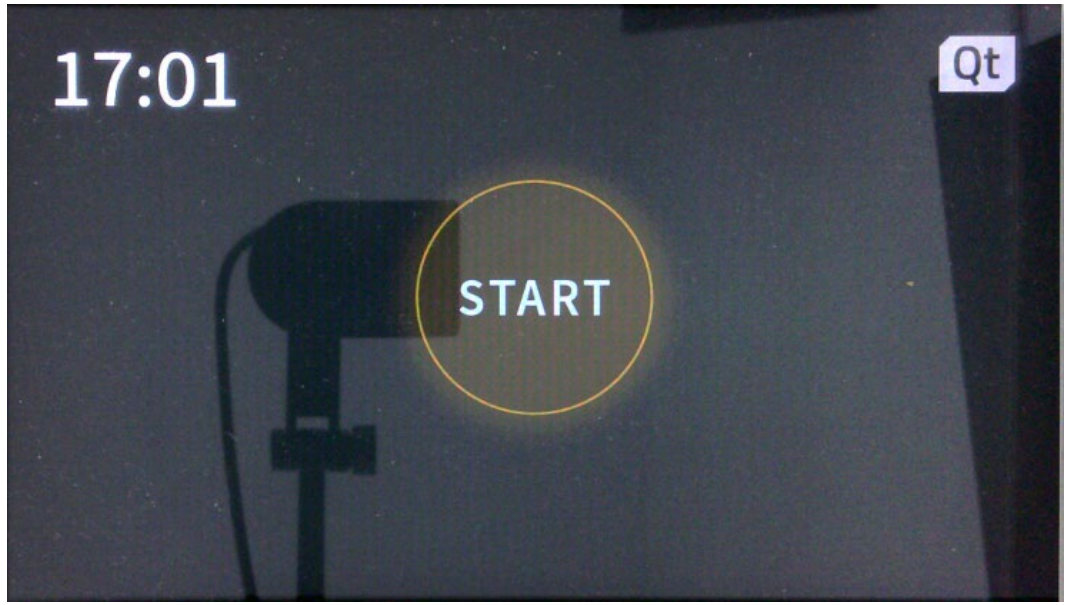
https://doc.qt.io/QtForMCUs-2.3/qtul-overview.html

- Oven interface
- Modern look and feel
- Product variants MCU, MPU
- Controls
- Multimedia
- Internet content access
- 3D animations





Qt Toolchain From Design to Deploy – MCU targets



Deploy

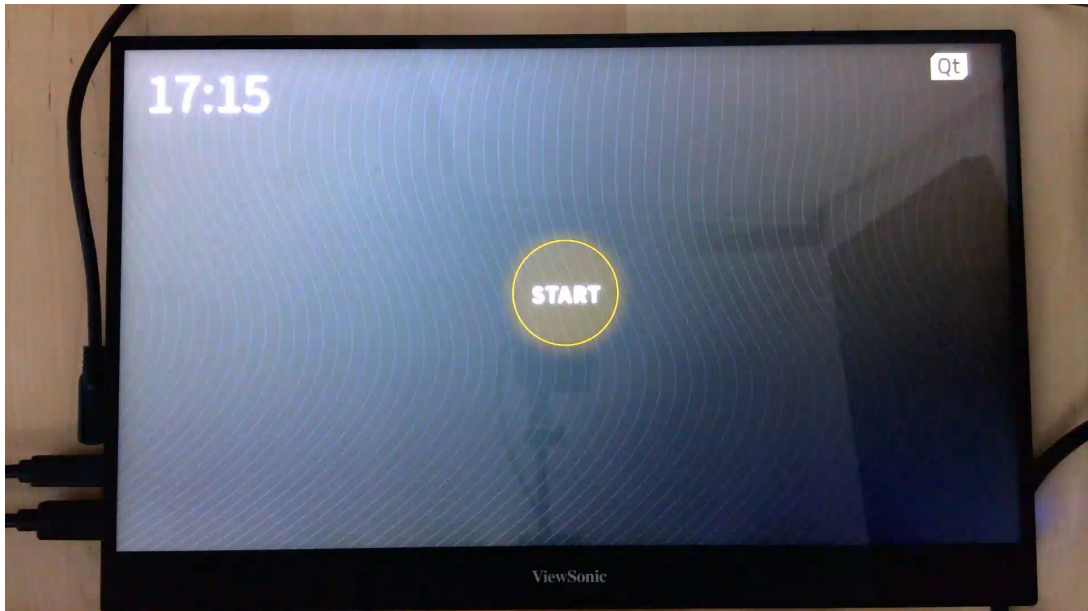
NXP i.MX RT1050

Figma, Sketch or Photoshop

Qt Design Studio – Design + UI/UX

Qt Creator – Backend C/C++ connection & Deploy

i.MX8 QM



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Qt for WebAssembly

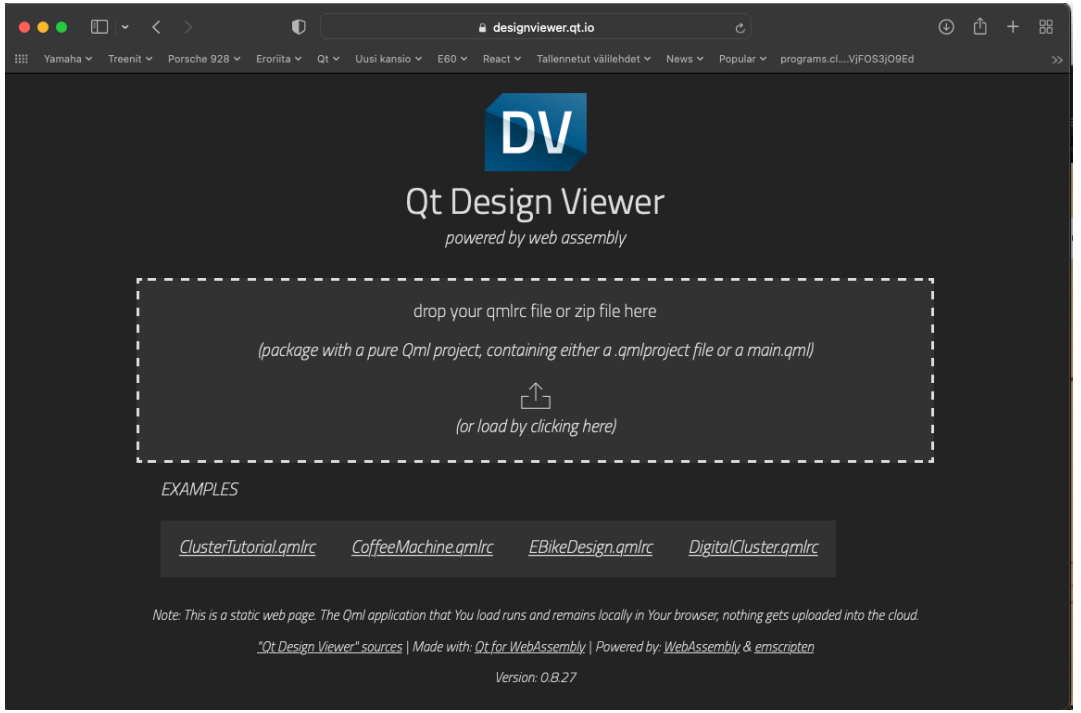
Key use cases of web -enabling your existing C/ C++ application and getting a web story using same team, same tools, same programming language

- Standard browser capability based on W3C standard in phones, tablets and computers – Big industry bet on zero install platform – recompile C++ code to run in browser's Javascript sandbox in binary format
- Some platform aspects under evolution
  - See Qt page: https://doc.qt.io/qt-6/wasm.html
- Comes with both client and server support – Qt supports the client side

Qt for WebAssembly

High Level Use Cases

- Benefit
  - Take your Qt application to the web using standard W3C browser capability
- Use-Cases
  - Taking native apps to the web – often requires working around platform limitations
  - Deploying apps without app stores – zero install
  - Sharing e.g. embedded designs with stakeholders
  - Embedded devices with no or limited display
  - Remote control and monitoring of devices in the field
- Content / Deliverables
  - Full support for WebAssembly in Qt 6.4+
  - Documentation and support



Qt Design Studio 3.8

Qt for WebAassembly Product Strategies

- In general WebAssembly has had higher performance compared to javascript, making it especially suited for more complex web apps.
- Please see Qt documentation for WebAssembly limitations https://doc.qt.io/qt-6/wasm.html
- Different architectures have been utilised as per webassembly.org
  - Entire code base in WebAssembly
  - Main frame in WebAssembly, but the UI in JavaScript / HTML
  - Re-use existing code by targeting WebAssembly, embedded in a larger JavaScript / HTML application

Areas for Special Consideration with Qt for WebAssembly

- Multithreading – needs to be enabled separately and is still experimental in WebAssembly, additionally multithreading requires modifying the server configuration
- SIMD performance enhancement – needs to be enabled separately on a need basis, may not help all apps.
- Networking – websockets are the basic mechanism although TCP/UDP sockets can be used as well with limitations. HTTP requests with limitations.
- Local file access – QFileDialog will display the virtual filesystem instead of the user's real filesystem.
- Clipboard access – some differences due to the web sandbox
- Debugging and profiling - Wasm debugging is done on browser javascript console, debugging applications on Wasm directly within Qt Creator is not possible.
- Fonts – only a few fonts supported by default, but this can be enhanced by the app.

https://doc.qt.io/qt-6/wasm.html

WebAssembly Use Case – Device Without Display

Code reuse

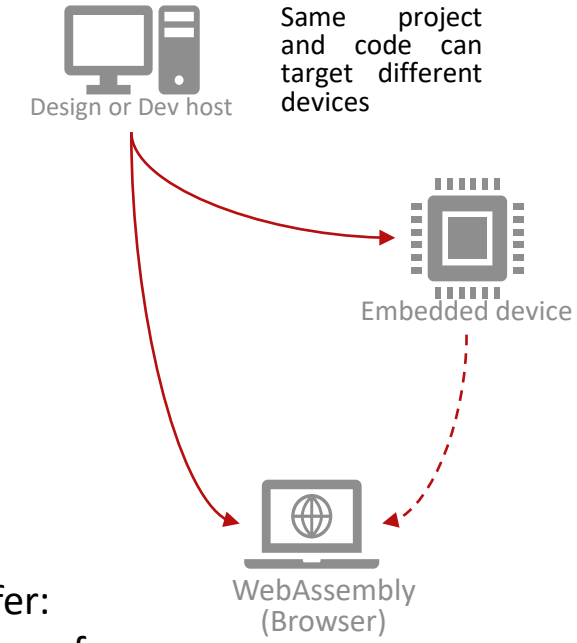
Allow embedded developers to have a web distribution story also:

- Qt HTTP server for hosting wasm binaries in embedded device
- Utilise ready interface technology between app front end (browser) and backend (embedded device)
  - All code does not have to run in browser
  - Wasm can be combined with HTML/ CSS ->faster startup

Solution for products without UI

Decide when to offer Qt mobile vs Qt WebAssembly

- Zero installation key for some projects



Qt can offer:
-3D wasm performance
-Data channel (gRPC, REST, etc)
-Low-end performance over HTML5
-Reuse of old code
-WebGPU (roadmap)

2

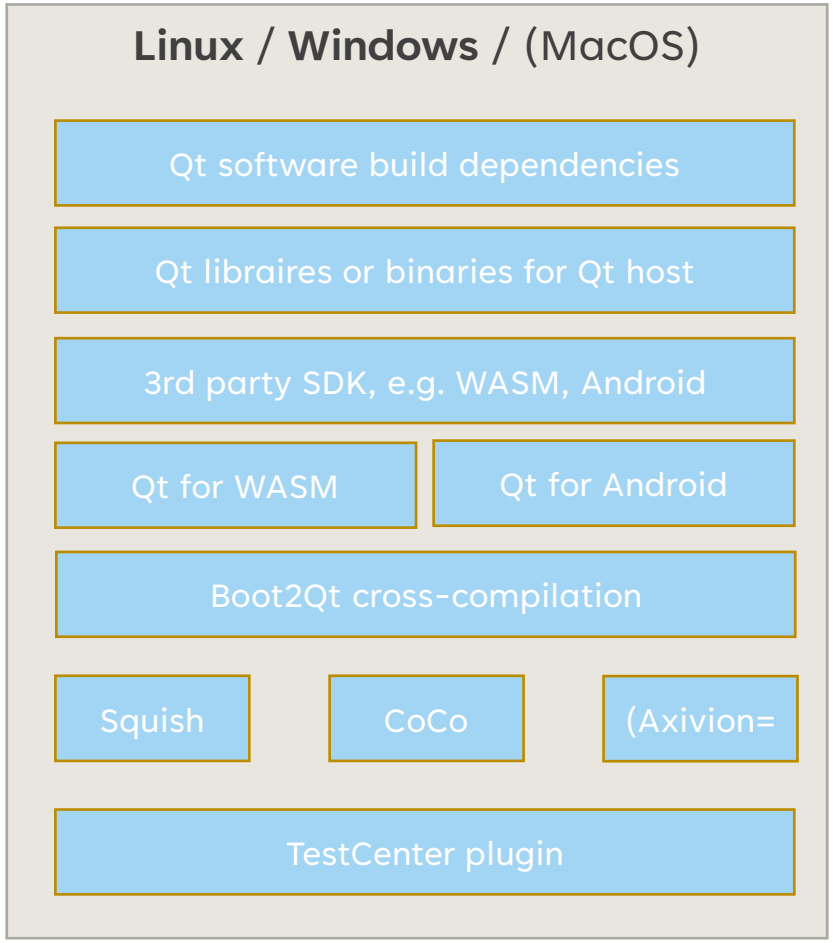
Qt in the Cloud – concept in validation phase

How you can use Qt in a cloud -based development environment to your benefit.

For piloting contact: qt_ci_cloud@qt.io

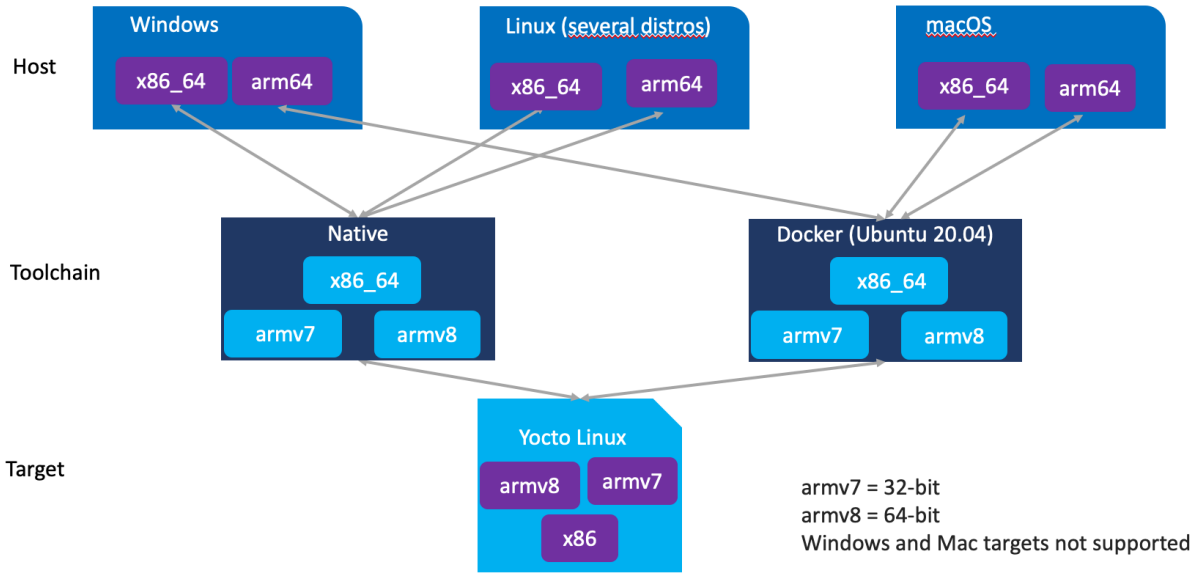
Qt CI/QA Cloud - Piloting

- **Qt container images which contain**
  - Prebuilt Qt libraries
  - Pre-packaged Qt dependencies
  - Pre-packaged QA tools
- **You can choose a specific container image with modules that are relevant to you**

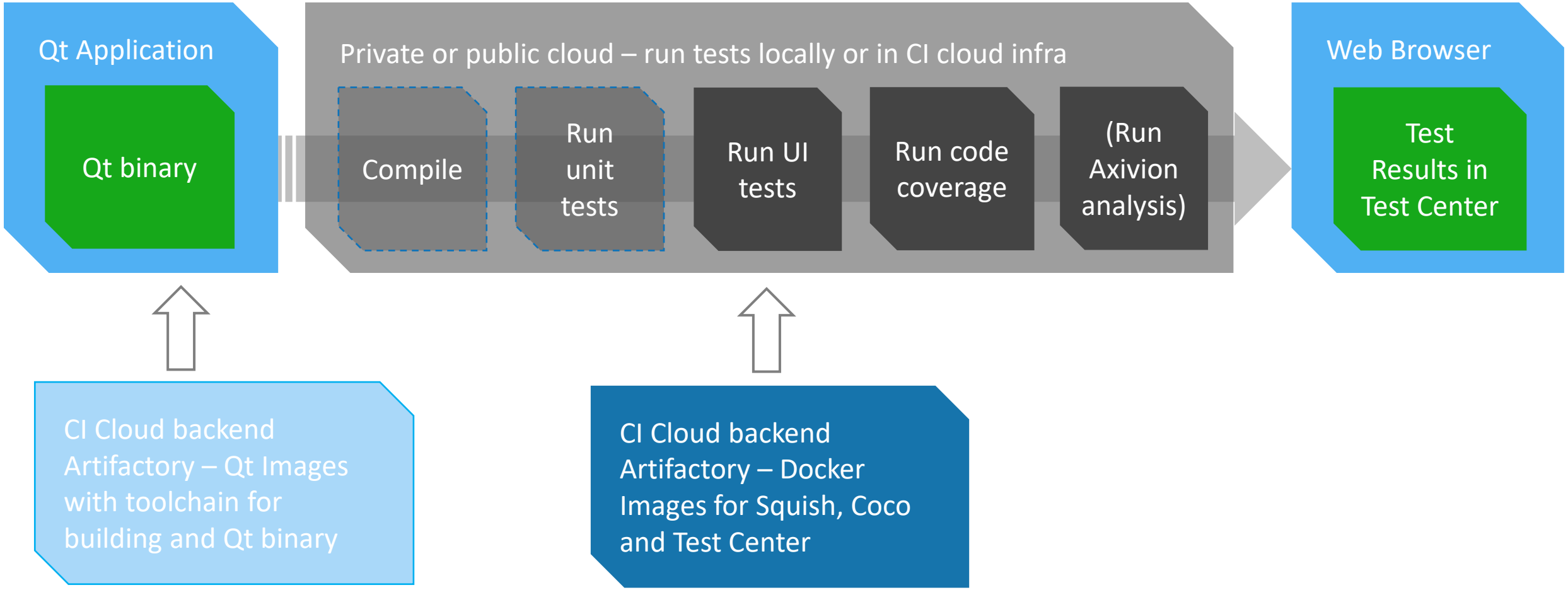


Containerized Development for Embedded Cross-Compilation

- Benefit
  - Broader embedded developer reach with new host platforms
  - More unified development environment
- Use Cases
  - Use macOS (Intel or ARM) for Boot2Qt development
  - Use Windows on ARM for Boot2Qt development
- Content / Deliverables
  - Docker image containing the Boot2Qt toolchain
  - Documentation



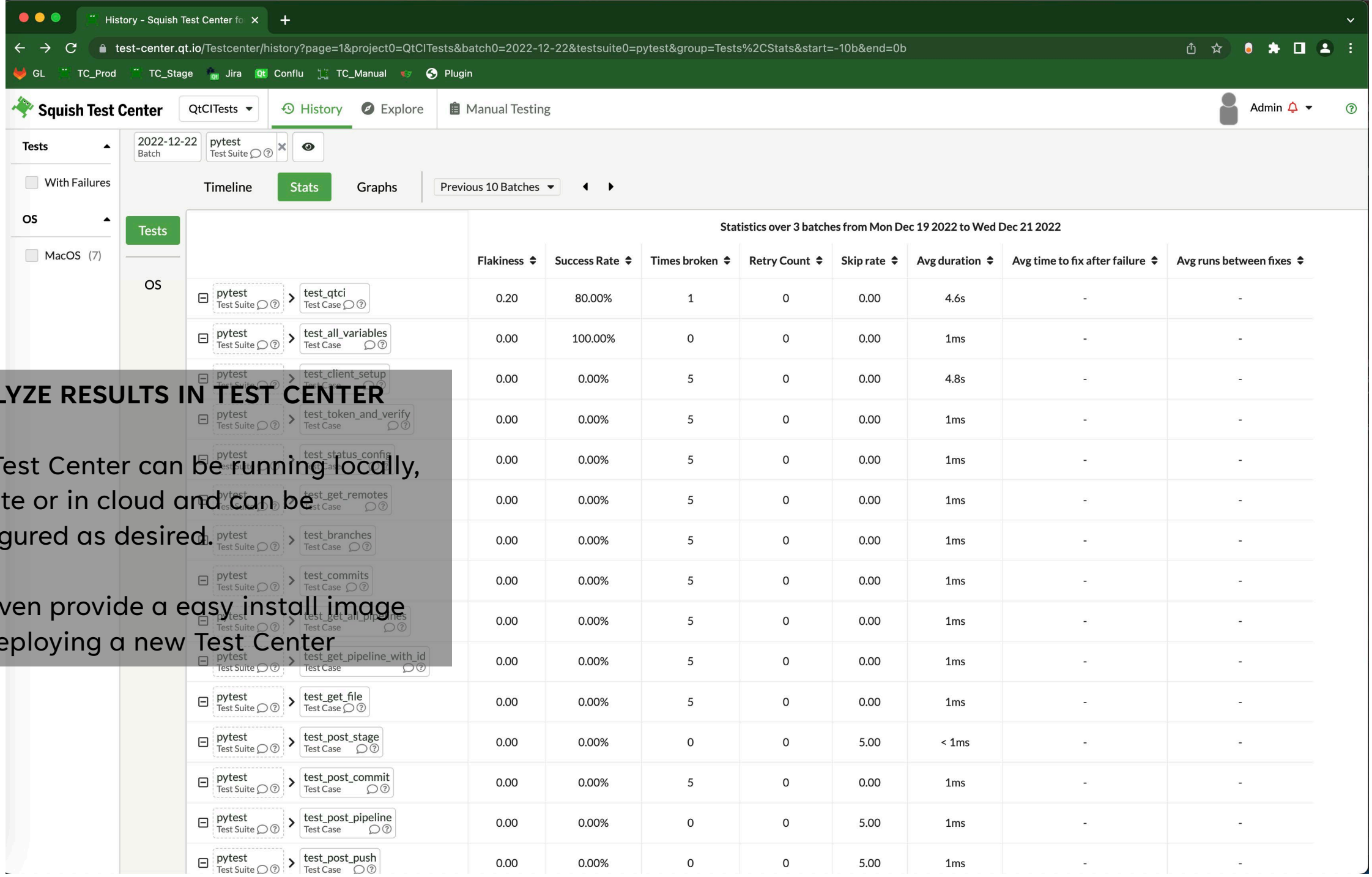
Qt CI/QA Cloud – Development Flow



Qt CI/QA Cloud

Demo Video for Squish UI Testing

Easy setup using containers
Headless operation
Test cases in Squish IDE



ANALYZE RESULTS IN TEST CENTER

The Test Center can be running locally, on-site or in cloud and can be configured as desired.

We even provide a easy install image for deploying a new Test Center

Qt HW Cloud Pilot

Use existing HW boards by Qt Group over the cloud for faster development and testing

- Web-based reservation of hardware
- SSH-access
- Supports running Squish UI–tests on selected HW
- HW selection
  - i.MX8 QuadMax
  - i.MX8 Nano
  - i.MX8 Mini
  - i.MX8M Quad
  - Toradex Apalis i.MX6
  - Raspberry Pi 4
  - Intel NUC

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Qt Angle to Digital Twins – concept in validation phase

Qt-based API simulation for speeding up your development project before you get the real hardware – piloting available soon

Qt Angle to Digital Twins

Background

Focus on the **needs of a UI application developer**

- To enable UI application development without hardware

Provide **simulation layers**

- For HW & OS related Qt APIs

Today

- Get HW and start developing SW

With Qt Digital Twin

- Test your designs without HW
- Develop without HW
- Code ready before HW available

"Test your designs without HW"

"Develop without HW"

"Code ready before HW available"

Why Qt Digital Twin?

Benefit

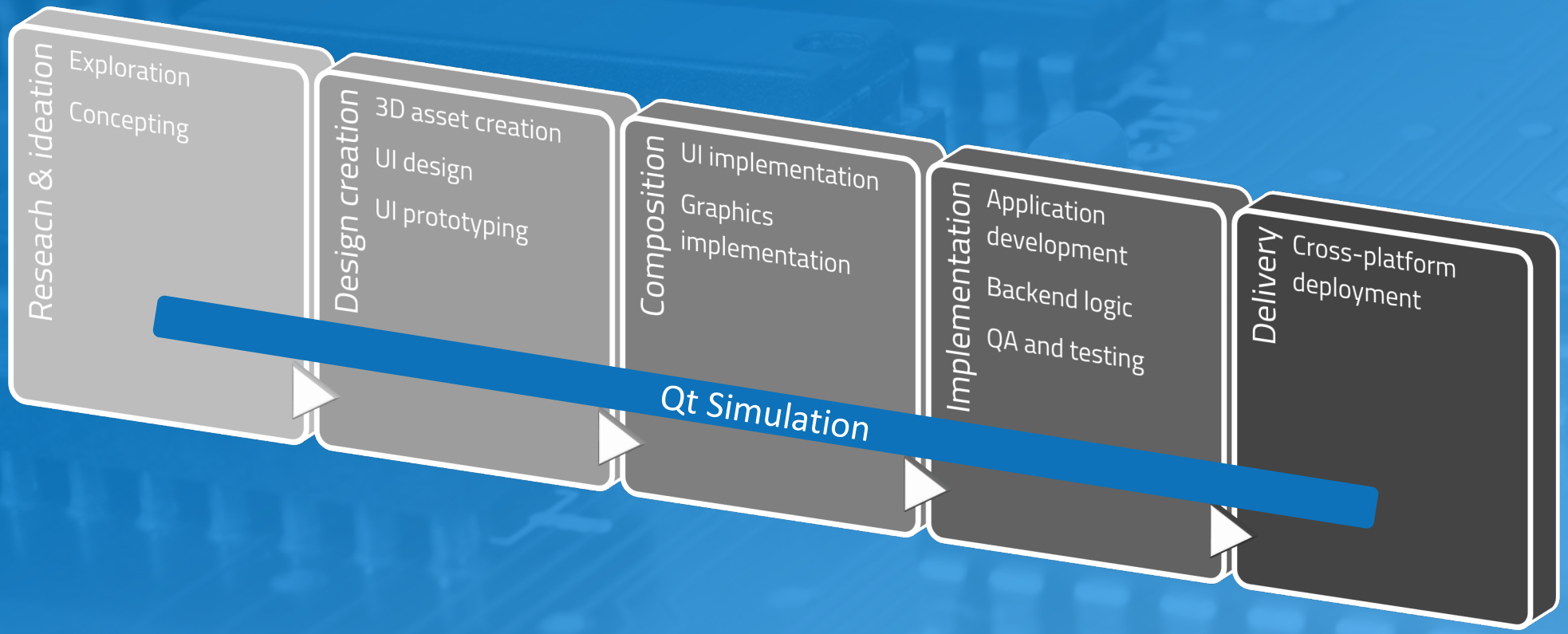
Qt Framework provides modules that abstract the underlying HW and OS services

This allows "***Code once, apply everywhere***"

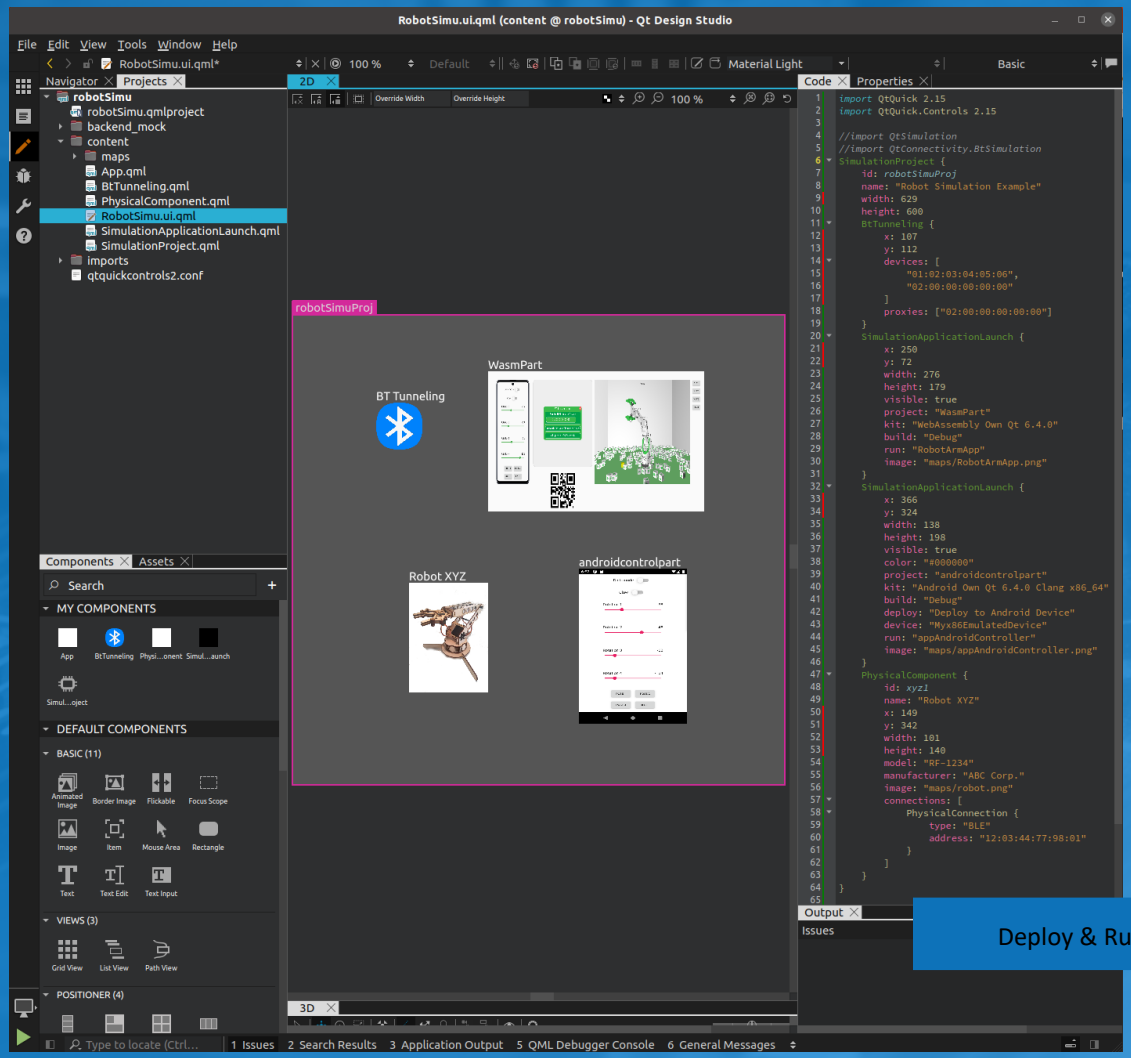
But it also allows ***simulation of HW and OS services*** transparently without modifications to the application SW

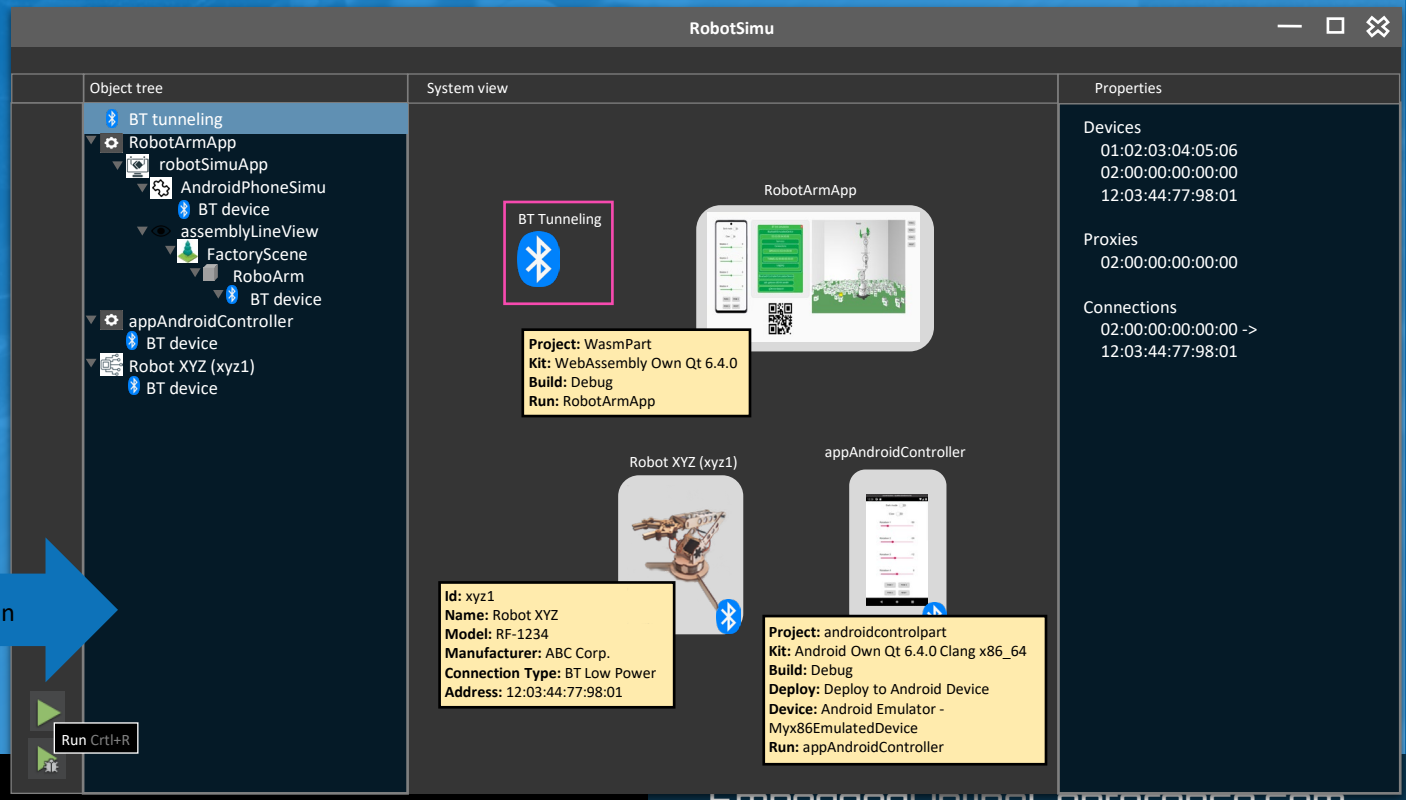
Role fo Qt Simulation Offering

Process



Design Flow of Qt Simulation Offering





API Support

First APIs

Qt Positioning API

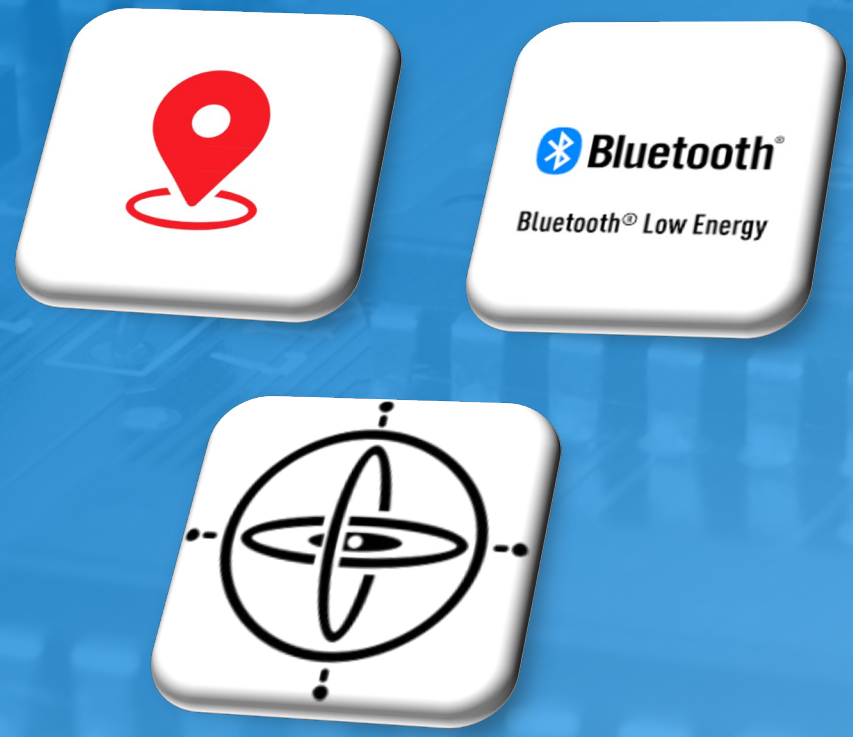
- To enable a factory floor demo
- https://doc-snapshots.qt.io/qt6-6.4/qtpositioning-index.html

Qt Bluetooth Low Energy API

- To extend the existing BT support
- To enable the control of a physical robot
- https://doc.qt.io/qt-6/qtbluetooth-le-overview.html

Qt Sensors API

- Needed for a factory floor demo
- https://doc.qt.io/qt-6/qtsensors-index.html



Bluetooth Simulation + Tunneling

Pilot

Qt Bluetooth API is the lst Qt API to get simulated

Simulation of BT protocol

- To provide virtual BT devices

Tunneling of BT signaling and data via WebSocket

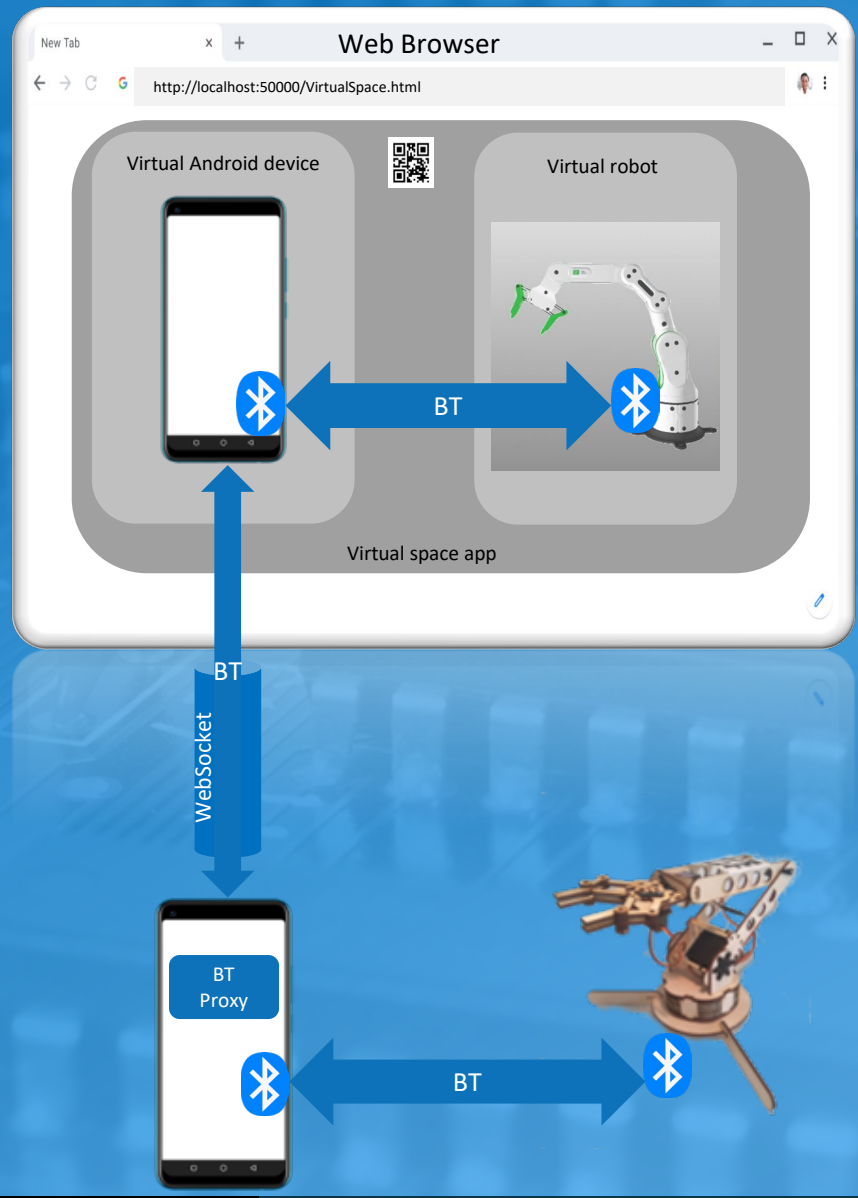
- To share the same BT network between (physical and virtual) BT devices

Proxying of BT signaling and data

- To allow any BT device (physical or virtual) to extend the shared BT network

Example use cases

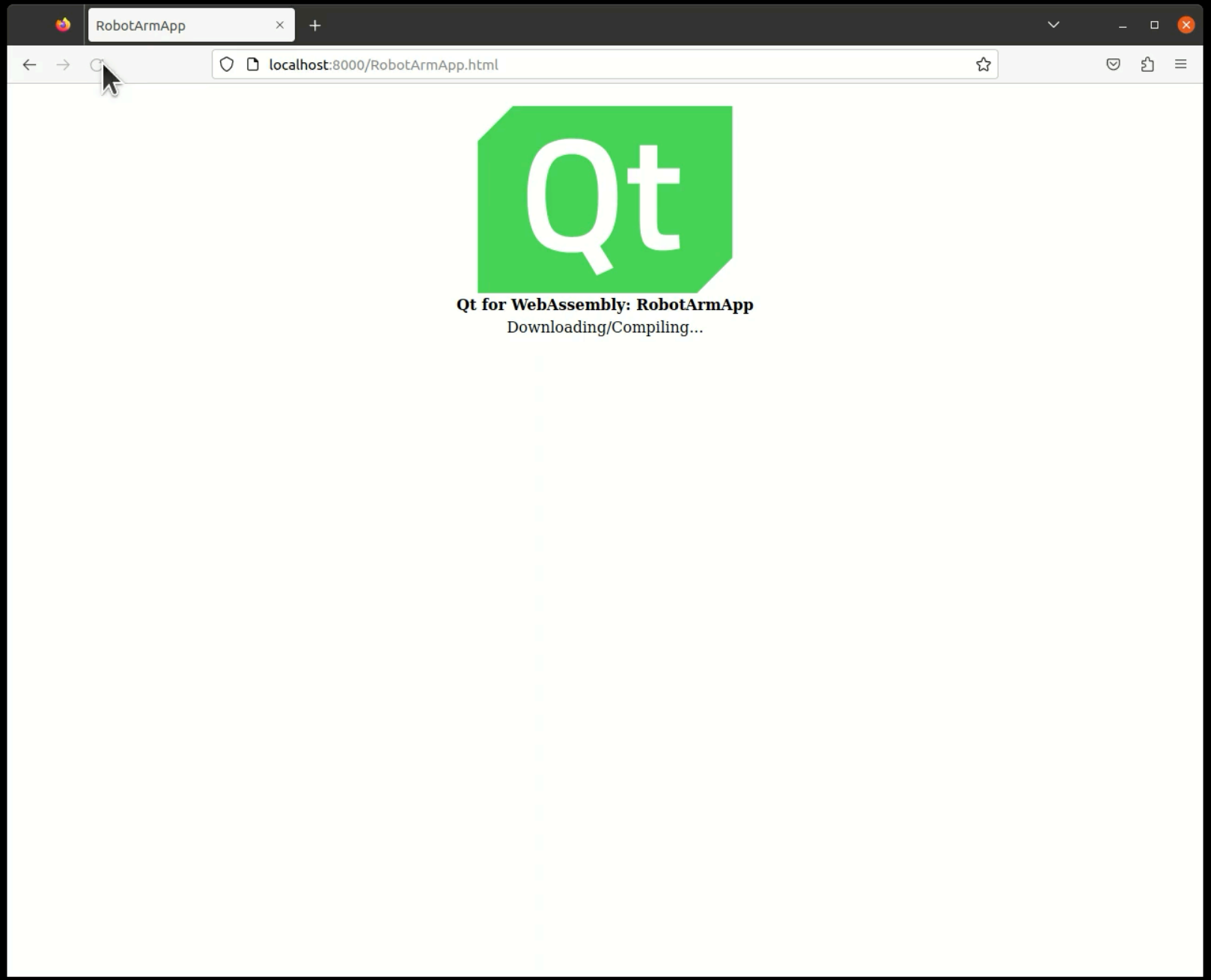
- To let a virtual Android device to control a physical robot
- To stream audio between a physical BT head set and a virtual Android device



Demo

Qt Bluetooth and Sensor APIs

Simulated environment



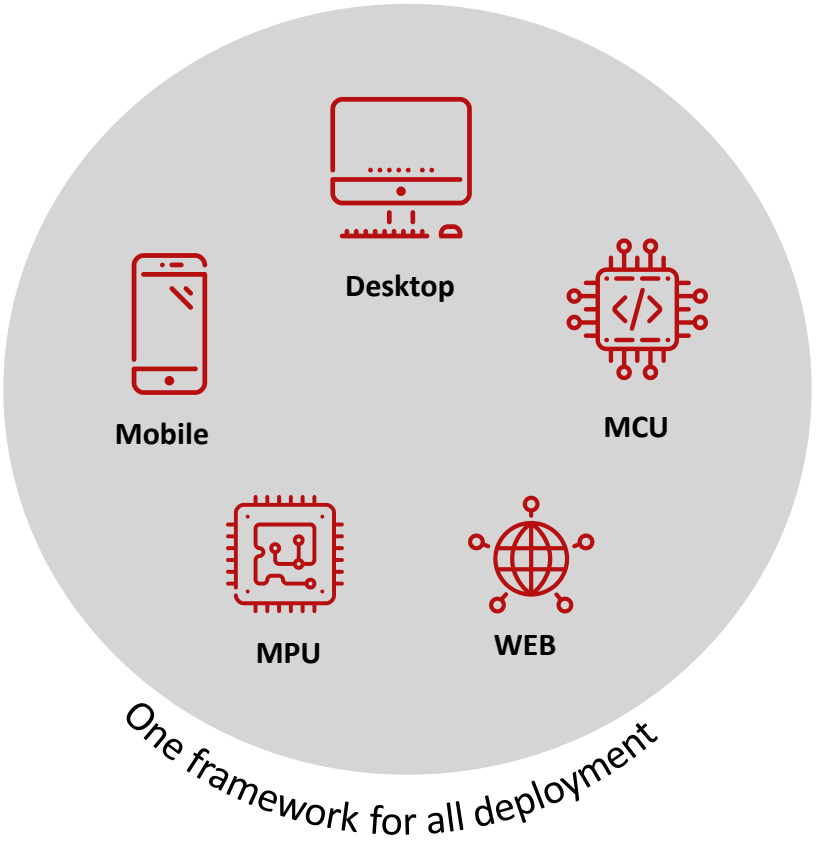
Summary

Key takeaways on extended Qt usage scenarious

Key Takeaways

Expanded Qt Use Cases – With Piloting Options in Concept Validation Phase

- In addition to the Qt framework Qt also provides a wide range of tools for design, development and test
- Qt can be used also with containers for easier deployment in development host or cloud
- WebAssembly offers a web story for C/C++ apps using same tools and teams
- API simulation with Qt Digital Twin for faster development soon in pilots



THANK YOU

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