Qt 6.0

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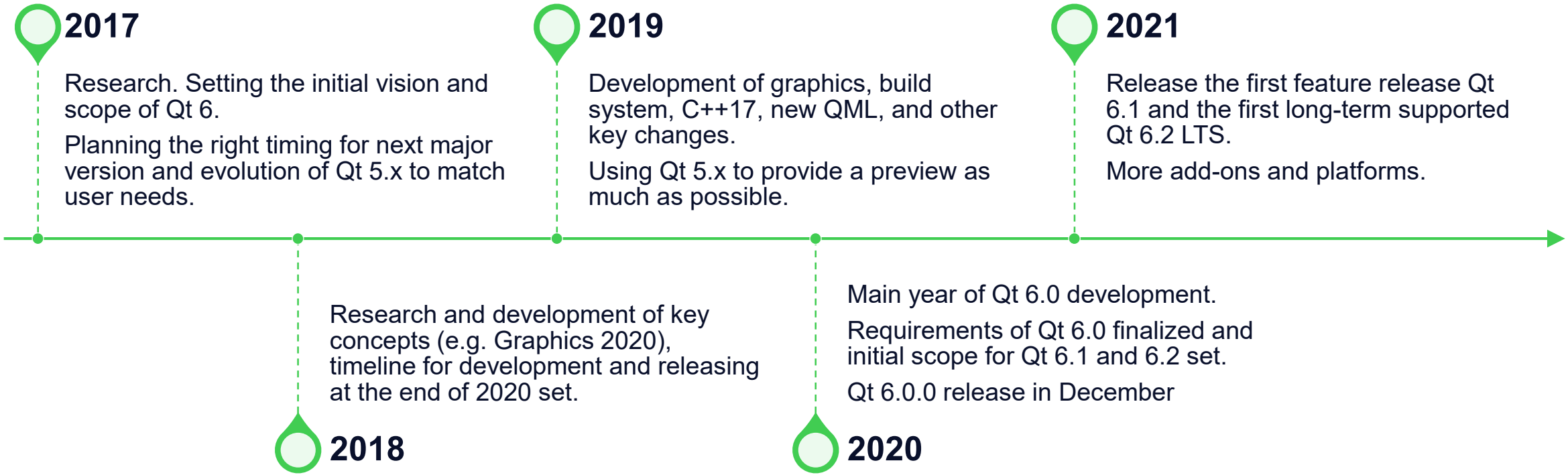
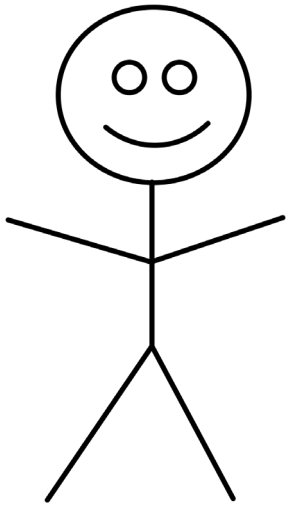
Wednesday 20th January

Qt 6 Timeline

Qt 6 Development Timeline



Package Manager – Additional Libraries for Qt 6

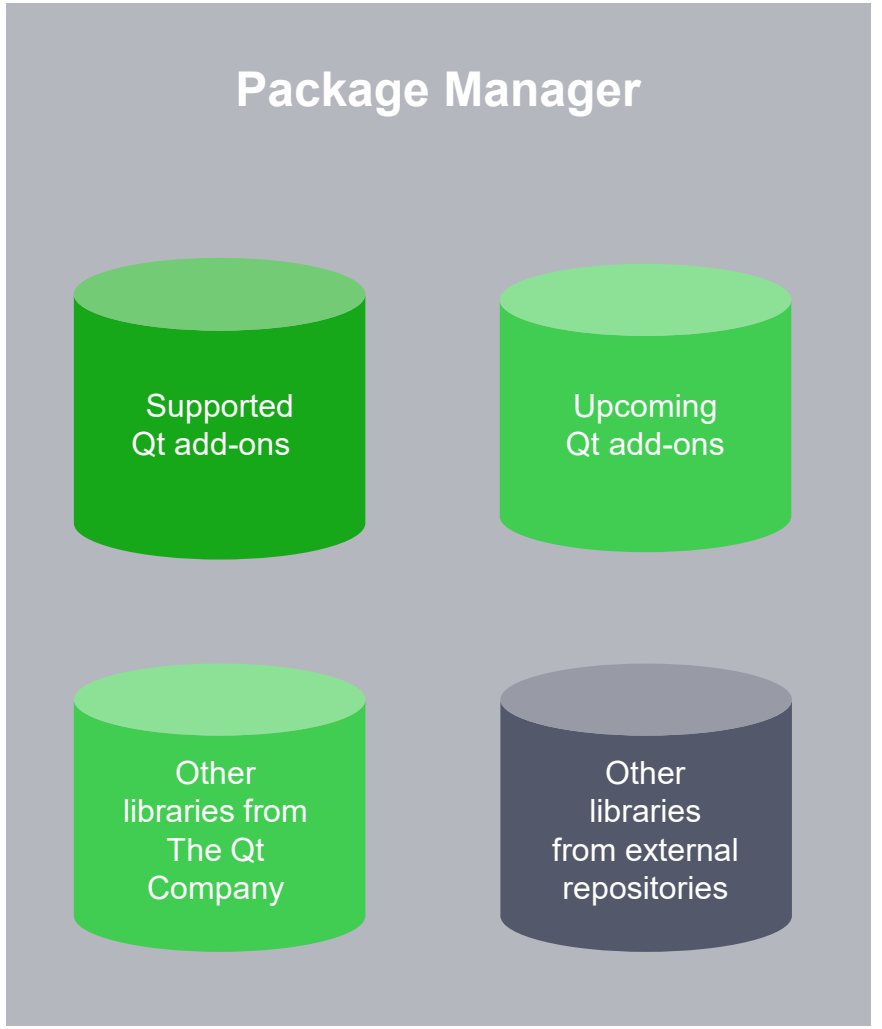


Qt user

Qt 6.x

Qt essentials +
“essential add-ons”

- ✓ Qt Core
- ✓ Qt Gui
- ✓ Qt Network
- ✓ Qt Widgets
- ✓ Qt QML
- ✓ Qt Quick
- ✓ Qt Quick 3D
- ✓ Qt Quick Controls
- ✓ Qt Print Support
- ✓ Qt Wayland + Compositor
- ✓ etc etc



Supported Essential and Add-on Modules in Qt 6

Qt 6.0 (released)

- Qt Concurrent
- Qt Core
- Qt Core Compat
- Qt D-Bus
- Qt GUI
- Qt Help
- Qt Network
- Qt OpenGL
- Qt Print Support
- Qt QML
- Qt Quick
- Qt Quick 3D
- Qt Quick Controls
- Qt Quick Layouts
- Qt Quick Timeline
- Qt Quick Widgets
- Qt Shader Tools
- Qt SQL
- Qt SVG
- Qt Test
- Qt UI Tools
- Qt Wayland
- Qt Wayland Compositor
- Qt Widgets
- Qt XML
- Qt 3D
- Qt Image Formats
- Qt Network Authorization
- M2M package: Qt CoAP
- M2M package: Qt MQTT
- M2M package: Qt OpcUA

Qt 6.1 (planned)

- Active Qt
- Qt Charts
- Qt Data Visualization
- Qt Lottie Animation
- Qt Quick Dialogs (File dialog)
- Qt ScXML
- Qt Virtual Keyboard

Qt 6.2 (planned)

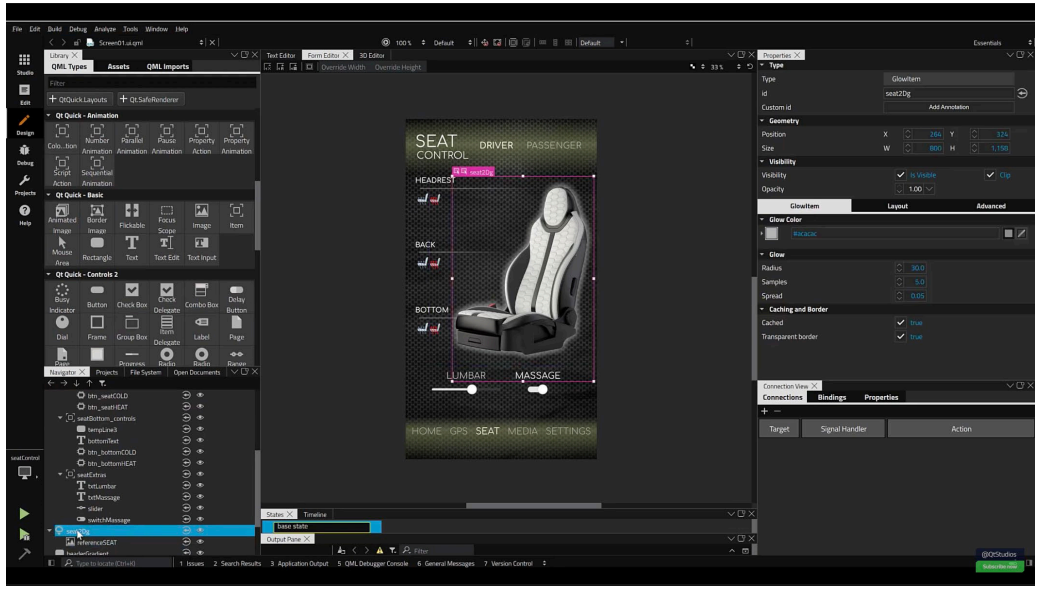
- Qt Bluetooth
- Qt Multimedia
- Qt NFC
- Qt Positioning
- Qt Quick Dialogs: Folder, Message Box
- Qt Remote Objects
- Qt Sensors
- Qt SerialBus
- Qt SerialPort
- Qt WebChannel
- Qt WebEngine
- Qt WebSockets
- Qt WebView

Designer Tools

QT DESIGN STUDIO 2.0

Unified 2D and 3D Design Tool

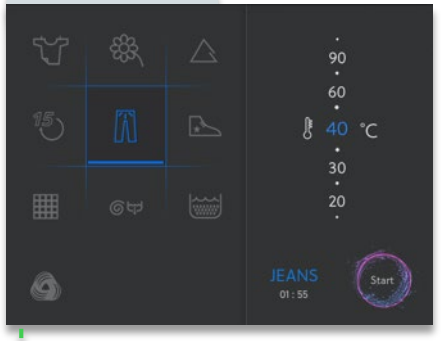
- Create 3D UI's with Qt Quick 3D in addition to traditional 2D UI design
  - Import designs from favorite 2D and 3D tools
  - Visual 3D editor to work with the scenes
  - Define keyframe-based timeline animations
  - Assign 3D effects
- Mix 2D and 3D content seamlessly inside your application



QT DESIGN STUDIO 2.0

Cross Product-line Development

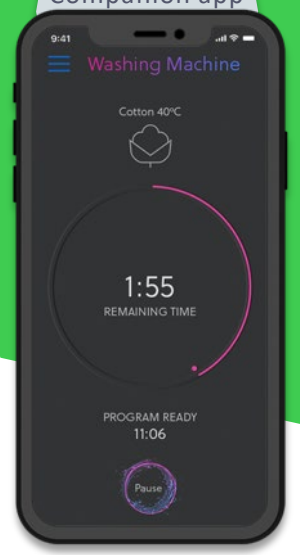
Low-end



Cortex-M4 MCU (<10 EUR BOM) – 640x480

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

Companion app



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

Mid-range

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

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

High-end

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

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

Developer Tools

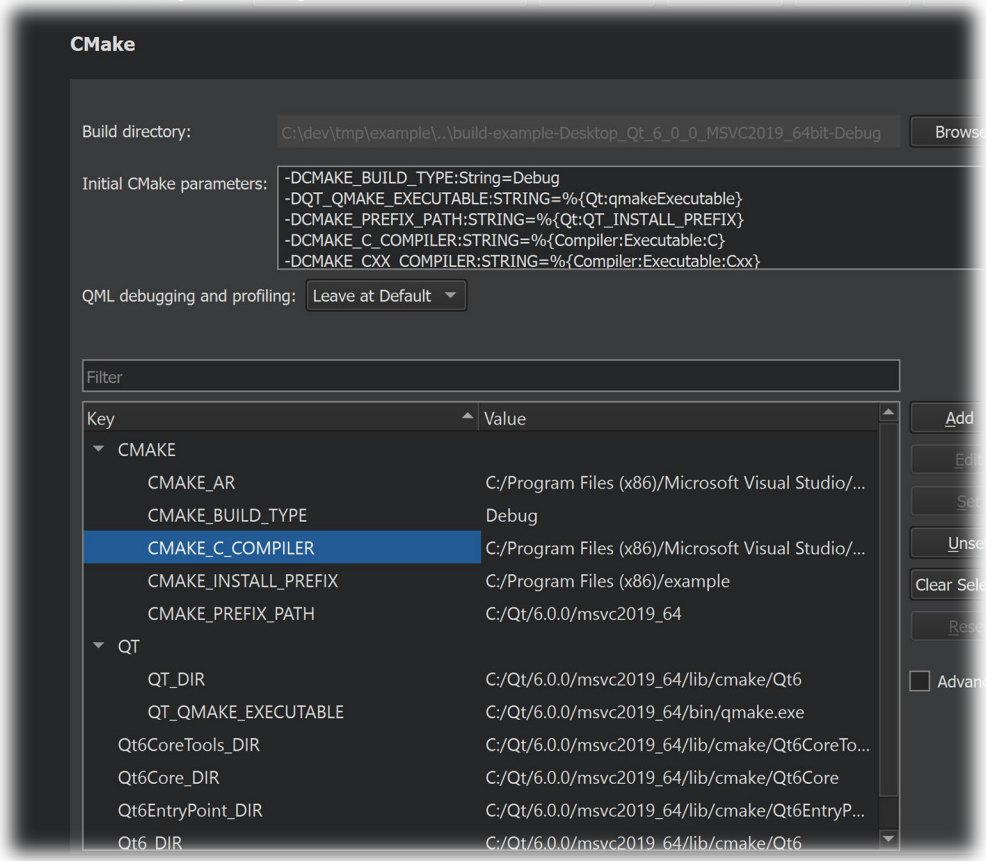
Developer Tooling Fully Supporting Qt 6

- Wizards generate Qt 6 compliant projects
- Inspect Qt 6 types in the debugger
- Editor knows the new QML and C++ language features
- Access Qt 6 documentation and examples

```
cmake_minimum_required(VERSION 3.14)

project(example LANGUAGES CXX)

set(CMAKE_INCLUDE_CURRENT_DIR ON)

set(CMAKE_AUTOUIC ON)
set(CMAKE_AUTOMOC ON)
set(CMAKE_AUTORCC ON)

set(CMAKE_CXX_STANDARD 11)
set(CMAKE_CXX_STANDARD_REQUIRED ON)

find_package(QT NAMES Qt6 Qt5 COMPONENTS Core REQUIRED)
find_package(Qt${QT_VERSION_MAJOR} COMPONENTS Core REQUIRED)

add_executable(example
  main.cpp
)
target_link_libraries(example Qt${QT_VERSION_MAJOR}::Core)

```

Constantly Improving CMake Support

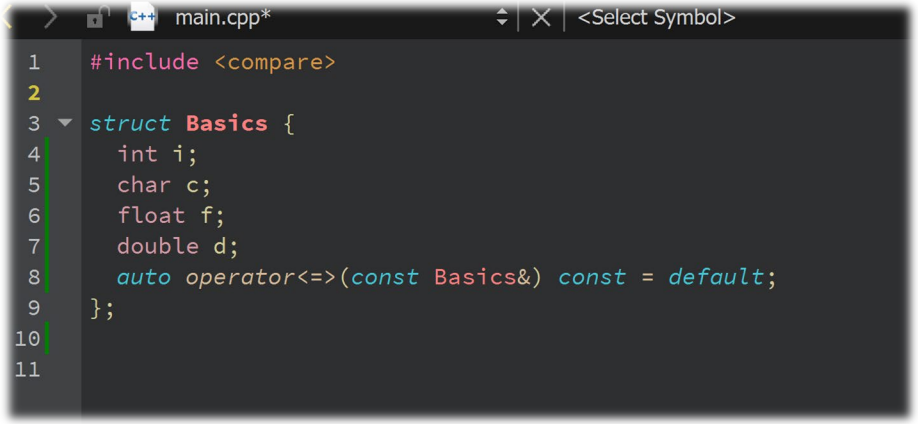
- Improved kit detection when importing builds
- Allow to re-use existing build directory
- Out-of-the box support for QML debugging and profiling
- Applications can still use qmake, if desired

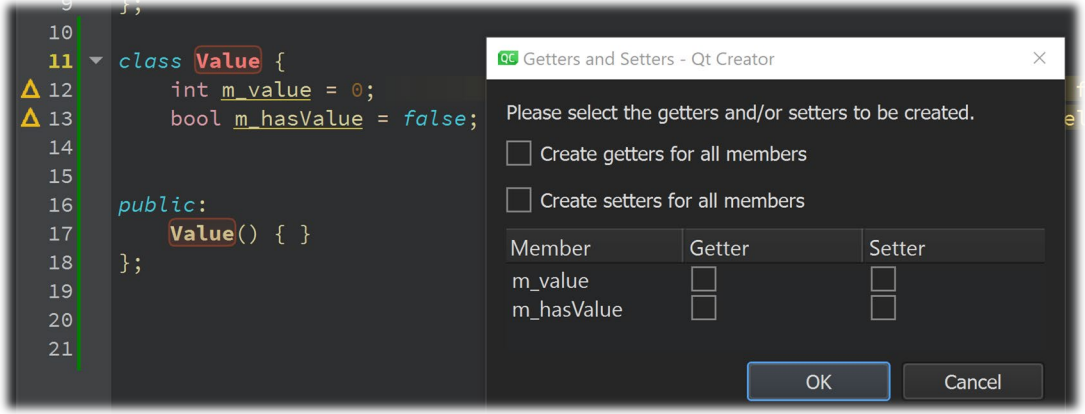


QT CREATOR 4.14

New Tools for C++ Development

- New and improved refactoring operations
- Clang code model to Clang 11
- Tighter integration of Clazy and Clang-Tidy
- Multiple improvements to C++ development throughout





Qt 6

Goals

> Fix architectural limitations in Qt 5
> Improved performance
> House cleaning
> Package management support
> Smaller and modular core product
> Compatibility with Qt 5

Core Values

> Cross platform
> Maintainability and compatibility
> Scalable
> Intuitive and easy to use
> Documentation
> Tooling

Focus on cleaning up our code base and architecture, not on new features

Compatibility

> Mostly source compatible with Qt 5
> Some porting required

- Requires some changes to source code
- Requires a recompile
- Deprecated functionality has been removed

> Those changes prepare us for the years to come

What’s new in 6.0?

Require C++17

- Require a C++17 compliant compiler
- Use features available in C++17
  - Structured bindings
  - if constexpr ()
  - Template argument deduction rules
  - New std library features
  - …

Containers

> Closed API gaps towards STL containers

- Consistent support for move operations
- Emplace
- initializer_list

> Removed 2G size limitation

- qsizetype

> Default constructors constexpr and non allocating

QList and QVector

> Only one class

- QVector is an alias to QList

> Simplifies our API

> Removed performance issues in Qt5 QList

- vector-based data structure
- Improves performance in almost all cases

> Almost 100% source compatible

- Exception: References to stored items not stable under modification

QMap and QHash

> Separated QHash/QMap and QMultiHash/QMultiMap

- Don’t inherit from each other anymore

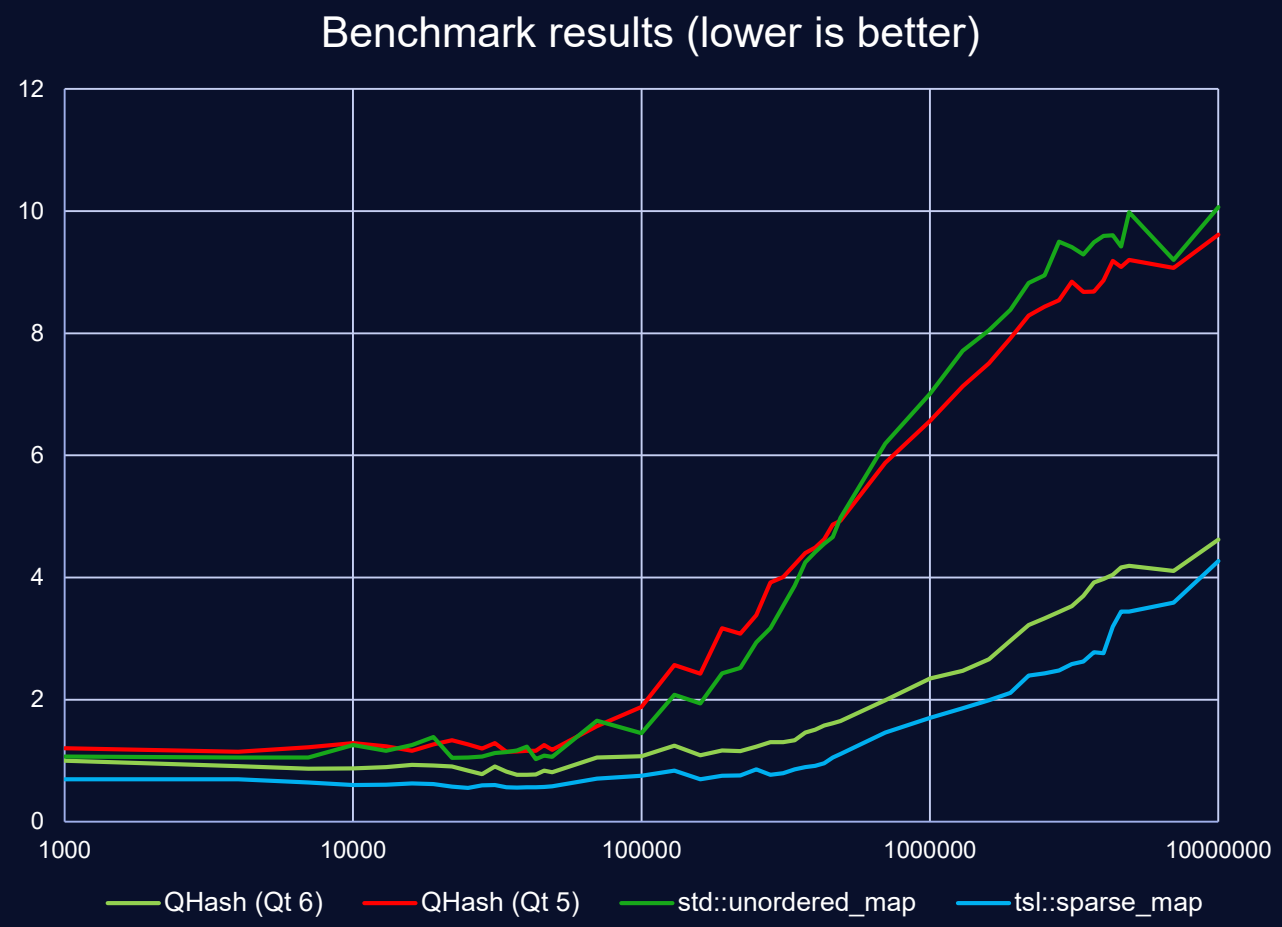
> Q(Multi)Map implemented on top of std::(multi_)map

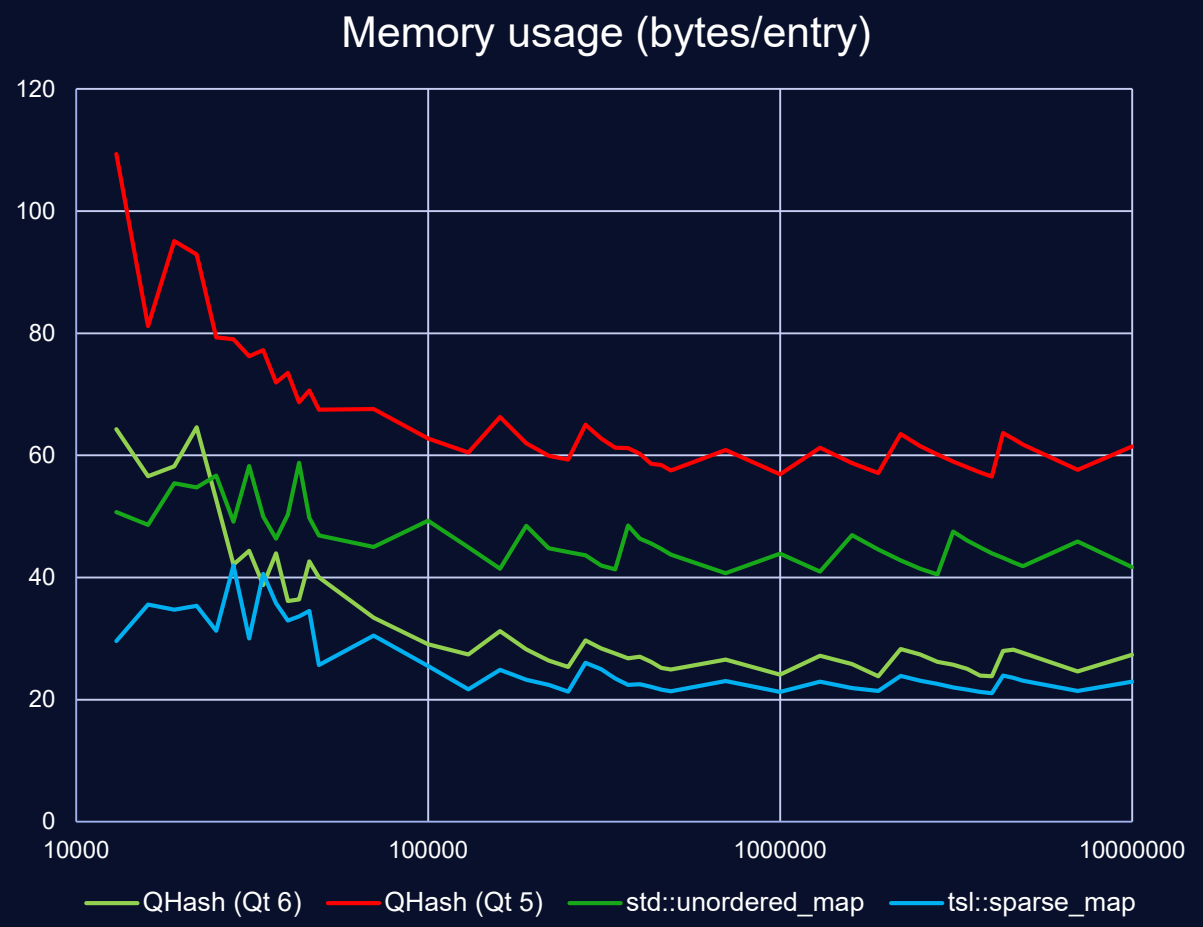
- Move support from/to std::map
- Implicitly shared

> New QHash implementation

- Open Adressing
- Fast
- Low memory usage

Performance: Hash<int64_t, int64_t>





Measurements done using
https://github.com/Tessil/hash-table-shootout.git

Unicode & String classes

> All text handling Unicode based

- UTF-16 the default string encoding
- UTF-8 the default storage format

> Source code is UTF-8

> Clean up string related classes

- Consistent set
- QUtf8StringView

> Move legacy encoding support out of Qt Core

String classes

> **QByteArray**
  - ASCII only, not Latin1
  - Meant for storing binary data

> **QUtf8StringView class**
  - Wrapper to tag UTF-8 specific data

> **Completed QStringView API**
  - Supports the const methods of QString

> **Removed QStringRef**
  - Still available in Qt5 compatibility library

Regular expressions

> Qt 6 uses QRegularExpression everywhere

- Only one regular expression engine
- Based on PCRE2

> QRegExp has been removed

- Porting to QRegularExpression usually straightforward
- Still available in Qt5 compatibility library

Text conversions

> New QStringEncoder/Decoder API

- Value based, stateful
- Supports UTF-8, UTF-16, UTF32, Latin1 and Local 8 bit
- Extensible to support full code conversions after Qt 6.0

> QTextCodec has been removed

- Still available in Qt5 compatibility library

Properties and bindings

```
import QtQuick 2.15

Rectangle {
    property int width
    property int height: width
    property int border: height/10
}
```

Goals

> Bring the best part of QML to all of Qt

> Move binding infrastructure into Qt Core

- Extend existing properties in QObjects with support for bindings
- Add binding support to any other class

> Support lazy binding evaluation

- Mark bindings as dirty when dependency changes
- Only re-evaluate when value is required

> Make it fast

```
struct Rectangle {
    QProperty<int> width;
    QProperty<int> height;
    QProperty<int> border;

    Rectangle() {
        height.setBinding(Qt::makePropertyBinding(width));
        border.setBinding([this]() {
            return this->height / 10;
        }
    }
};
```

```
template <typename T> class QProperty {
    std::function<T()> binding = nullptr;
    T data;
public:
    T value() const {
        if (binding) return binding();
        return data;
    }
    void setValue(const T &newValue) {
        if (binding) binding = nullptr;
        data = newValue;
    }
    void setBinding(std::function<T> b) { binding = b; }
};
```

```
template <typename T>
class QProperty {
    T val;
    QPropertyBindingData d;
public:
    T value() const {
        if (d.hasBinding()) d.evaluateIfDirty(this);
        d.registerWithCurrenlyEvaluatingBinding();
        return this->val;
    }
    void setValue(const T &t) {
        d.removeBinding();
        if (this->val == t) return;
        this->val = t;
        notify();
    }
};
```

QObject complicates the picture

> Existing property infrastructure

- Avoid breaking compatibility with Qt 5
- Extend the existing property()/setProperty() mechanism

> Data hiding

- Data lives in QObjectPrivate

> Avoid overhead if bindings aren’t used

Solution

> Binding support a simple addition to the existing system

> Add a getter for a binding interface

- QBindable<PropertyType> bindableProperty();

> Extend Q_PROPERTY with a BINDABLE tag

- Tells moc about the binding interface

> Use Q_OBJECT_BINDABLE_PROPERTY to implement the data storage

- Only works as a member of a QObject

> Low overhead if bindings aren't used

- One additional pointer in QObjectPrivate

```
class MyObject : public QObject {
    Q_PROPERTY(int x GET x SET setX BINDABLE bindableX)
    Q_OBJECT_BINDABLE_PROPERTY(MyObject, int, xData)
public:
    int x() { return xData; }
    void setX(int x) { xData = x; }
    QBindable<int> bindableX() { return &xData; }
};


myObject->bindableX().setBinding([otherObject]() {
    return otherObject->x() + otherObject->width();
}
```

QMetatype and QVariant

> Common backend for QMetaType and QVariant

- QMetaType can finally handle all types

> High performance, fast code paths

- QMetaType contains one pointer to a handler struct
- Automatic registration
- Automatic support for comparisons and QDataStream

> Deprecated integer-based type id

- Use QMetaType directly

```
struct QMetaTypeInterface {
    uint size, alignment;
    const char *name;
    ConstructFn construct;
    DestructFn destruct;
    EqualsFn equals;
    ...
};

class QMetaType {
    QMetaTypeInterface *iface;
public:
    const char *name() const { return iface->name; }
    void construct(void *where) { iface->construct(where); }
};
```

Improvements to moc

> Store and resolve required metatype information at compile time

- No more string lookups for type information
- Faster and more efficient runtime resolution of methods

> Added support for bindable properties

- Dynamically add and remove bindings

Rewritten Concurrent

> Simple chaining of computations
  - `QFuture::then()`
> Attach failure and cancellation handlers
  - `QFuture::connect()`
> Convert signals to QFuture objects
> Added a QPromise class
> Support for custom thread pools

```
QByteArray download(const QUrl &url);
QImage loadImage(const QByteArray &data);
void show(const QImage &image);

auto future = QtConcurrent::run(download, url)
                    .then(loadImage)
                    .then(show)
                    .onFailed([](QNetworkReply::NetworkError) {
                        // handle network errors
                    });
```

Further improvements

> Multiple improvements in Qt Network

- SSL/TLS improvements
- HTTP/2 support by default
- Write your own plugins for QNetworkAccesManager

> Added Qt5Compat module

- Ease porting to Qt 6
- Contains some deprecated classes from Qt 5

Unified Pointer events

> Unified handling of mouse, touch and tablet events

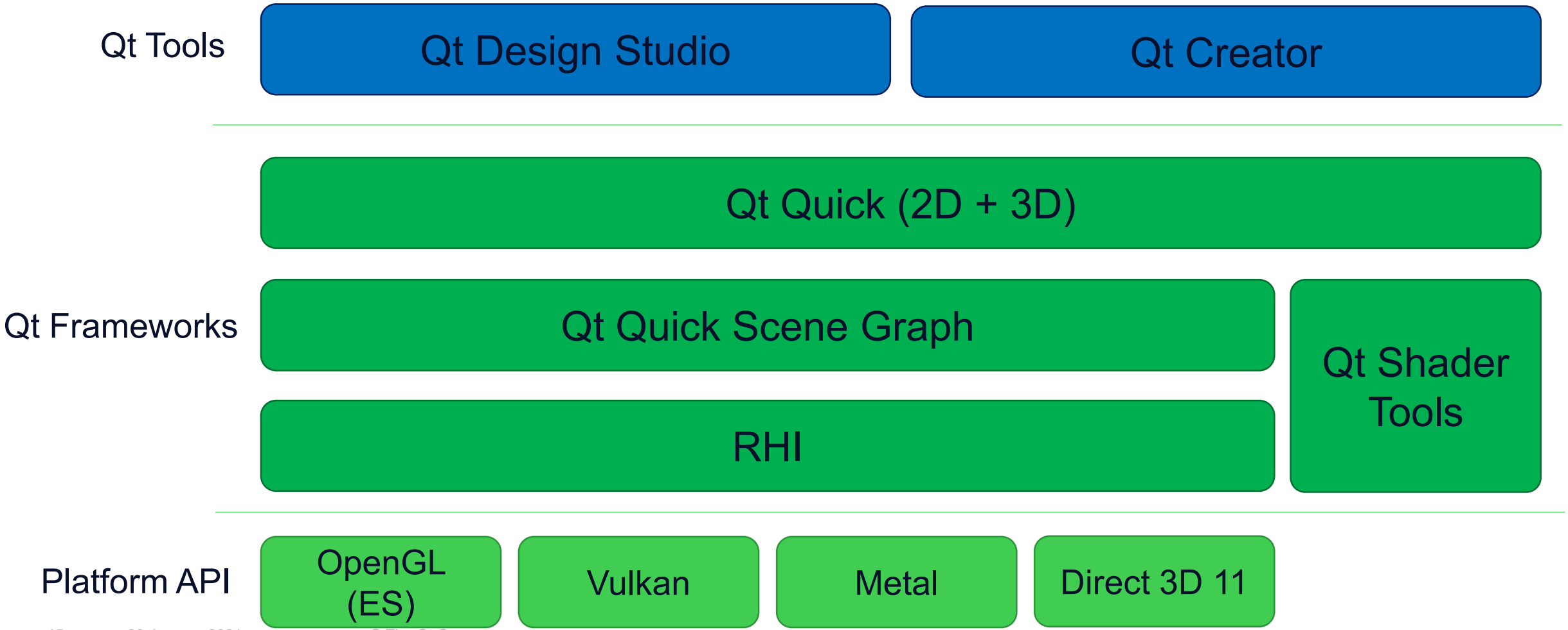
- One common base class: QPointerEvent
- Specializations for mouse, touch and tablet events
- Common data
- Tracking of input device and history of event points

> Resolves recurring issues with touch handling in complex controls

- e.g. touch enabled controls inside Flickable

Graphics

Graphics Architecture



Rendering Hardware Interface

> Abstraction layer for 3D graphics APIs

- OpenGL, Metal, Direct 3D 11, Vulkan

> Abstracts graphical objects

- Materials, Meshes, Shaders, etc.
- Internal API tuned towards the needs of Qt

> Integrated with Qt Platform and Window system abstraction layers

> Qt Quick and Qt Quick 3D are fully ported to RHI

Qt Shader Tools

> Support for cross platform shaders

- Write shader once
- Recompile to all graphics APIs

> Support for build time and runtime shader compilation

- Dynamically generate shaders at runtime
- Bake the shaders offline

Qt 6 uses the native graphics API of each operating system

Quick 3D

> Efficiently combine 2D and 3D in one scene

- One optimized scene graph

> Enhanced PBR support

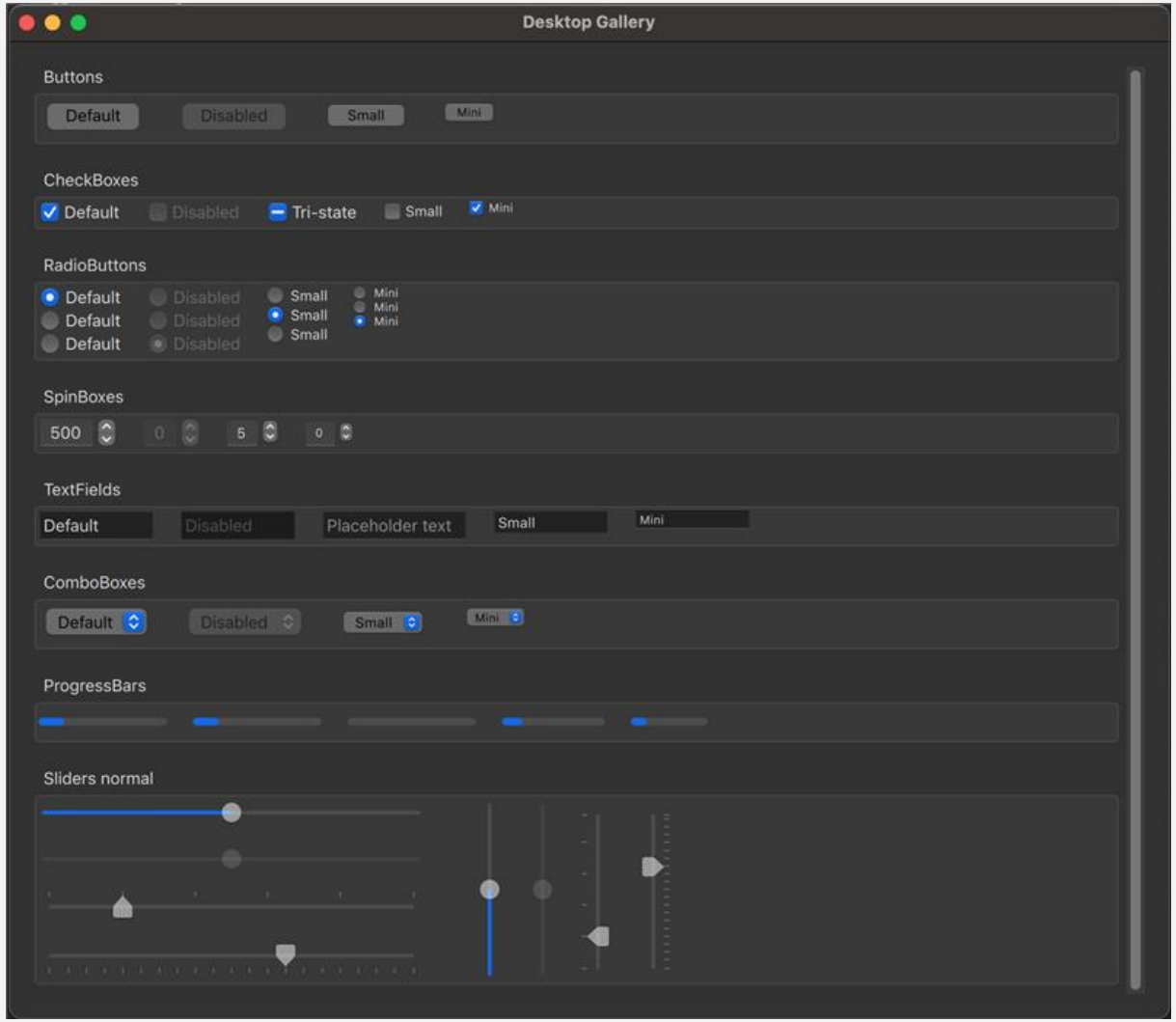
- Materials look like they are designed

> Greatly improved support for GITF2

- Support base spec
- Most of the common extensions

Desktop style for Quick Controls

Native look and feel for Qt Quick Controls on macOS, Windows and Linux



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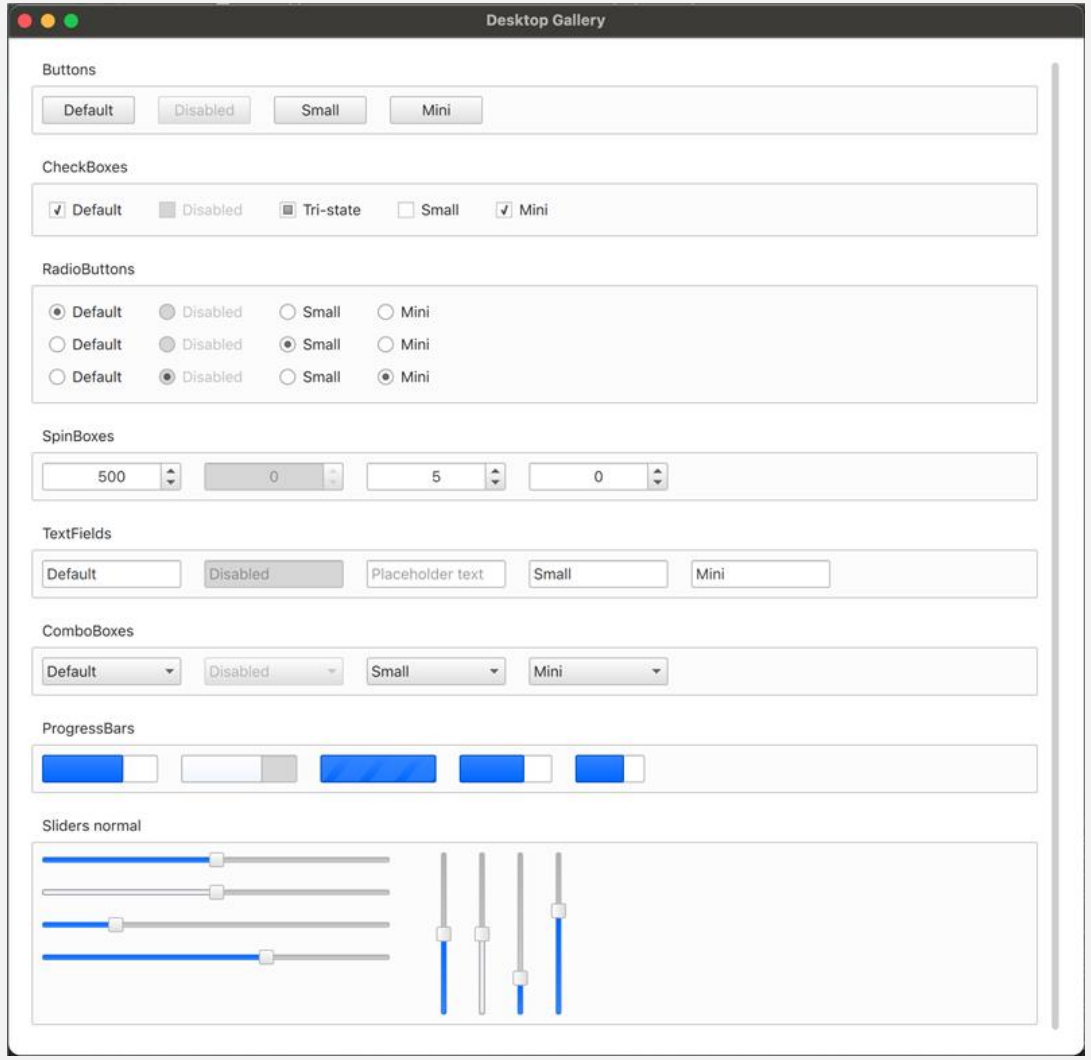
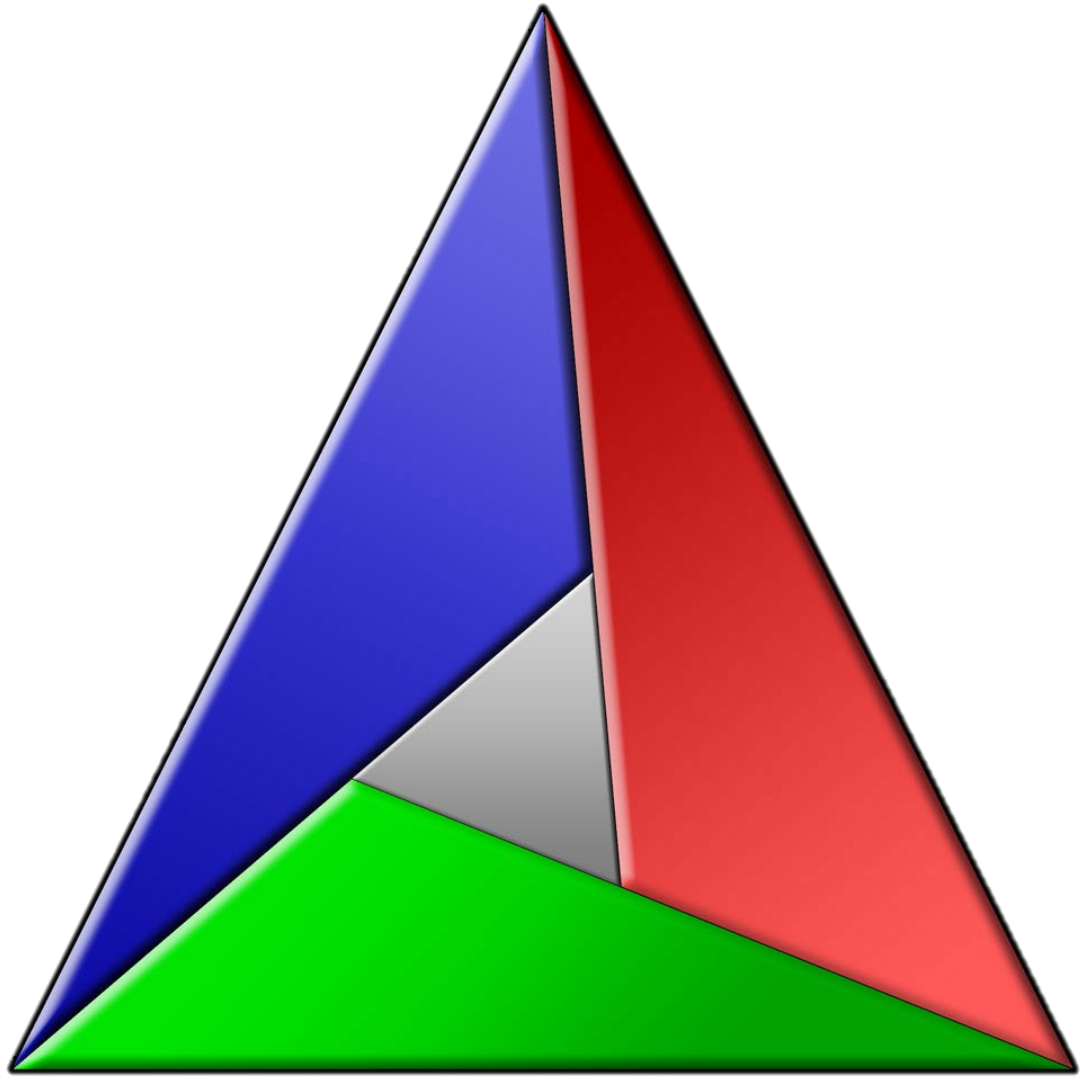


CMake



Supported platforms

> Host platforms

- Windows 10
- macOS 10.15 and 11.0
- Linux (Ubuntu 20.04, CentOS 8.1, SLES 15, OpenSUSE 15.1)

> Target platforms

- All host platforms
- Yocto 3.1 Dunfell
- iOS 13/14
- Android (28 built-time, 21 run-time)

Roadmap for other platforms

> macOS on ARM

- Timing not yet confirmed

> Yocto 3.2

- Planned for Qt 6.1

> QNX & INTEGRITY

- Technology Preview with Qt 6.1
- Full support planned for Qt 6.2

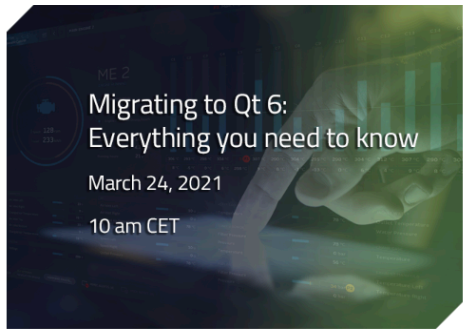
Release roadmap

- **Qt 6.0** December 2020
- **Qt 6.1** End of April 2021
- **Qt 6.2 LTS** End of September 2021

Outlook

- **Porting the remaining Qt Add-ons to Qt 6**
  - Delivered through the package manager as they are ready
- **Make most properties bindable**
- **Wider C++ API for Qt Quick and Qt Quick Controls**
- **Improvements to QML performance**
- **Improvements in native styling, accessibility and graphics features**

Want to Know More?



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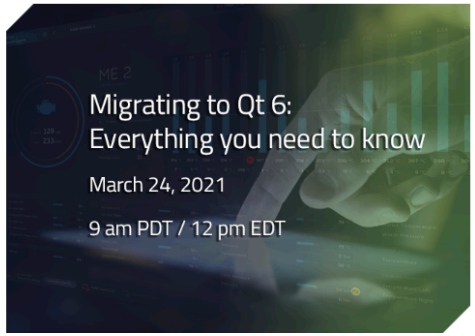

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