Write Event-based programs again sequentially
or
how to Clean Code in asynchronous programs.

Helge Betzinger
CTO
pcvisit Software AG

pcvisit

Agenda

- What is the problem and how to escape?
- coasync4cpp let you program TODAY without callbacks!
- Where to go from here?
- No more Callbacks!

What is the problem and how to escape?

A typical requirement for a application these days…

If the user clicks the button, than replace the image within his clipboard by a URL with a copy of this image within the cloud.

What is the problem and how to escape?

A typical requirement for a application these days...

If the user clicks the button, than replace the image within his clipboard by a URL with a copy of this image within the cloud.

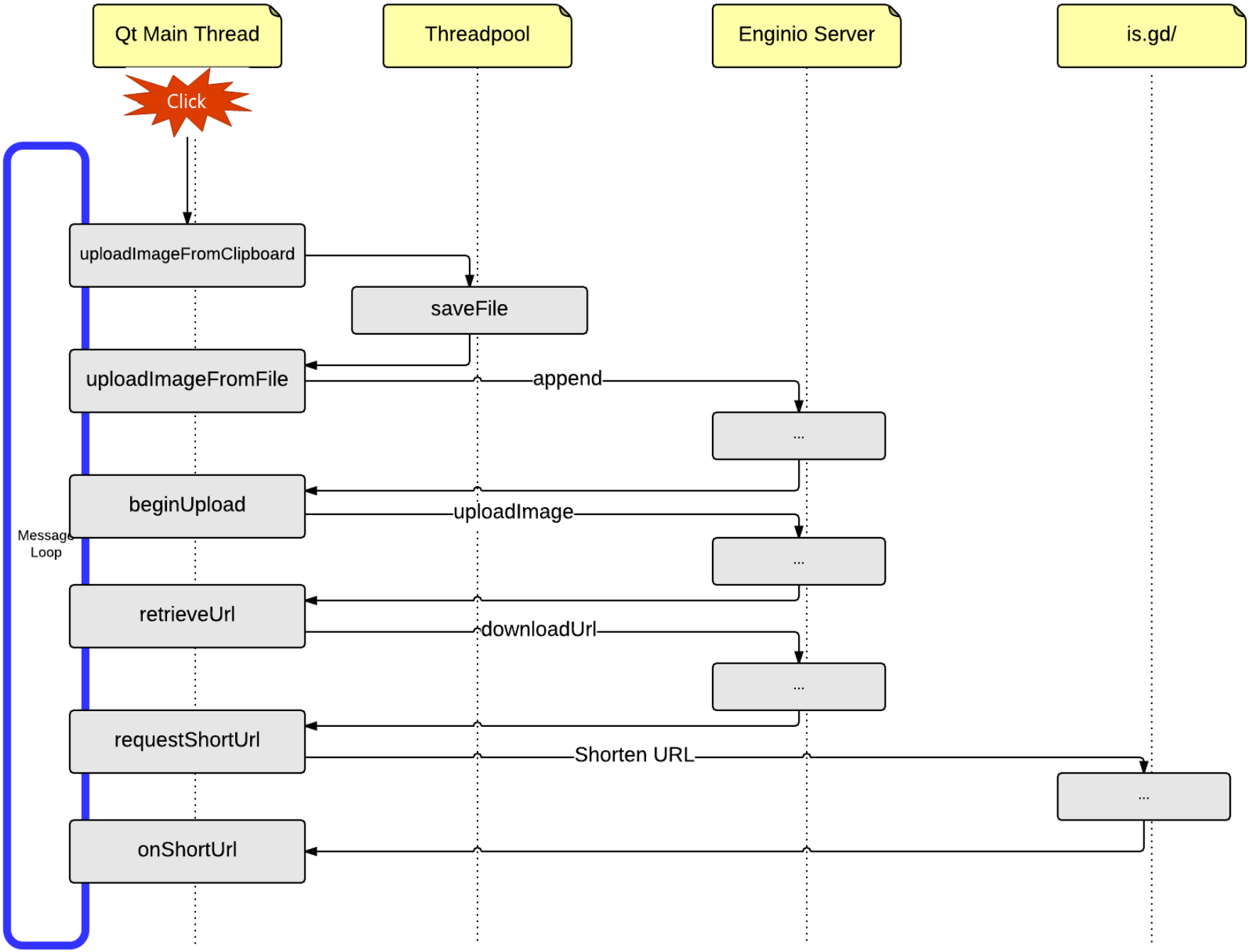
please wait for the next slide
clicking won't make it come any faster

A typical requirement for a application these days…

If the user clicks the button, than replace the image within his clipboard by a URL with a copy of this image within the cloud.

The UI must stay responsive all the time.

Async becoming the norm!


Qt Main Thread
Threadpool
Enginio Server
is.gd/
Click
uploadImageFromClipboard
saveFile
uploadImageFromFile
append
...
beginUpload
uploadImage
...
Message Loop
retrieveUrl
downloadUrl
...
requestShortUrl
Shorten URL
...
onShortUrl

Example: Concurrent waiting with signals


```
void MainView::uploadImageFromFile(const QString &filePath)
{
    QJsonObject object;
    // configure object …
    EnginioReply *reply = mModel.append(obj
    connect(reply, &EnginioReply::finished,
            this, &MainView::beginUpload);
}

void MainView::beginUpload(Enginio
    reply->deleteLater();
    // use result/reply here ..
}
```

1) Manage the control flow of the application

2) Manage resources of the infrastructure

3) Business logic related code

Example: Concurrent waiting with futures

C++11

```
File saveCliprdToDisk();

std::future<File> f = std::async(saveCliprdToDisk);

f.get() ; // this blocks, until saveCliprdToDisk is done!
          // even the destructor of std::future blocks!
```

Example: Concurrent waiting with boost

C++ standard proposal N3558, Boost.Thread 1.55.0

```
boost::future<File> f = boost::async(saveCliprdToDisk);

f.then( [] (boost:: future<File> savedF ) {
        // use result.get() here ...
        uploadImage( savedF.get()).then(
                [=] (future<Reply> uploadedFile) {
                        requestUrl (uploadedFile.get()).then(
                                ...
                        );
                }
        );
});
```

And what about Clean Code?


THY WILL BE DONE

Document number: N3721
Date: 2013-08-30
Reply-to: Niklas Gustafsson <niklas.gustafsson@microsoft.com>
Artur Laksberg <arturl@microsoft.com>
Herb Sutter <hsutter@microsoft.com>
Sana Mithani <sanam@microsoft.com>

discarded for C++17

Improvements to std::future<T> and Related APIs

... how to escape?

Document number: N4134
Date: 2014-10-10
Reply-to: Gor Nichanov <gor@microsoft.com>
Jim Radigan <jradigan@microsoft.com>

Resumble Functions (stackless coroutines)

Document number: N4134
Date: 2014-05-2[illegible]
Reply-to: Oliver [illegible]owalke <oliver.kowalke@gmail.com>
[illegible]Goodspeed <nat@lindenlabs.com>

stackfull coroutines

included in C++17?

coasync4cpp
let you do asynchronous programming without callbacks
TODAY!

Coasync4cpp - How it works


```
std::future<File> f = std::async(saveCliprdToDisk);

File f = f.get() ; // this blocks, until saveCliprdToDisk is
done!
```

Coasync4cpp - How it works

~~`std::future<File> f = std::async(saveCliprdToDisk);`~~

~~`File f = f.get() ; // this blocks, until saveCliprdToDisk is done!`~~

```
File f = Task( boost::async( saveCliprdToDisk ));
```

```
File f = await Task( boost::async( saveCliprdToDisk ));
```

```
File f = await boost::async( saveCliprdToDisk );
```

Task<...>

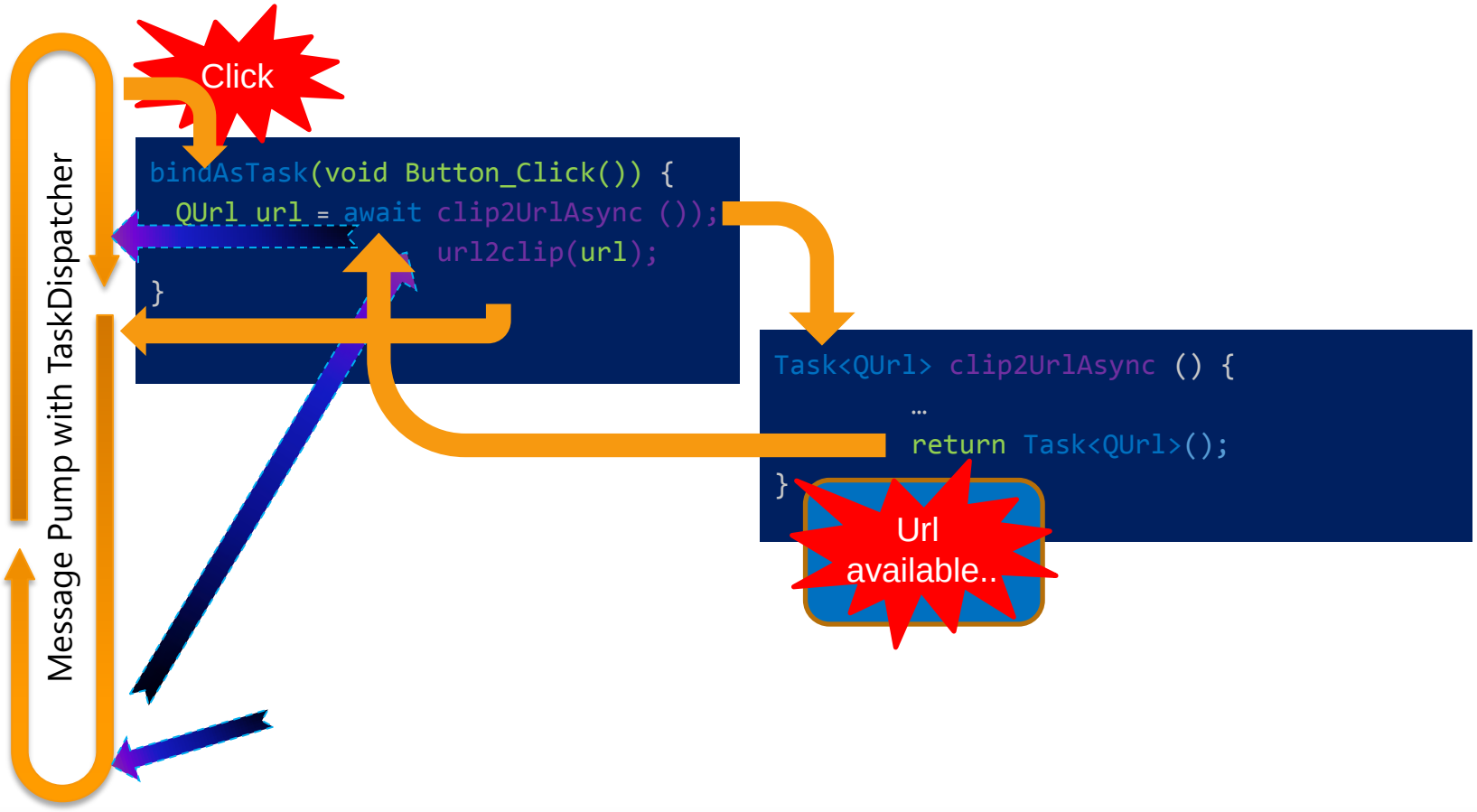
Wrap around a awaitable to make code simpler

Allows to use Task/await within a routine

await

Unwraps value of a given awaitable without blocking your thread

Understanding async Tasks

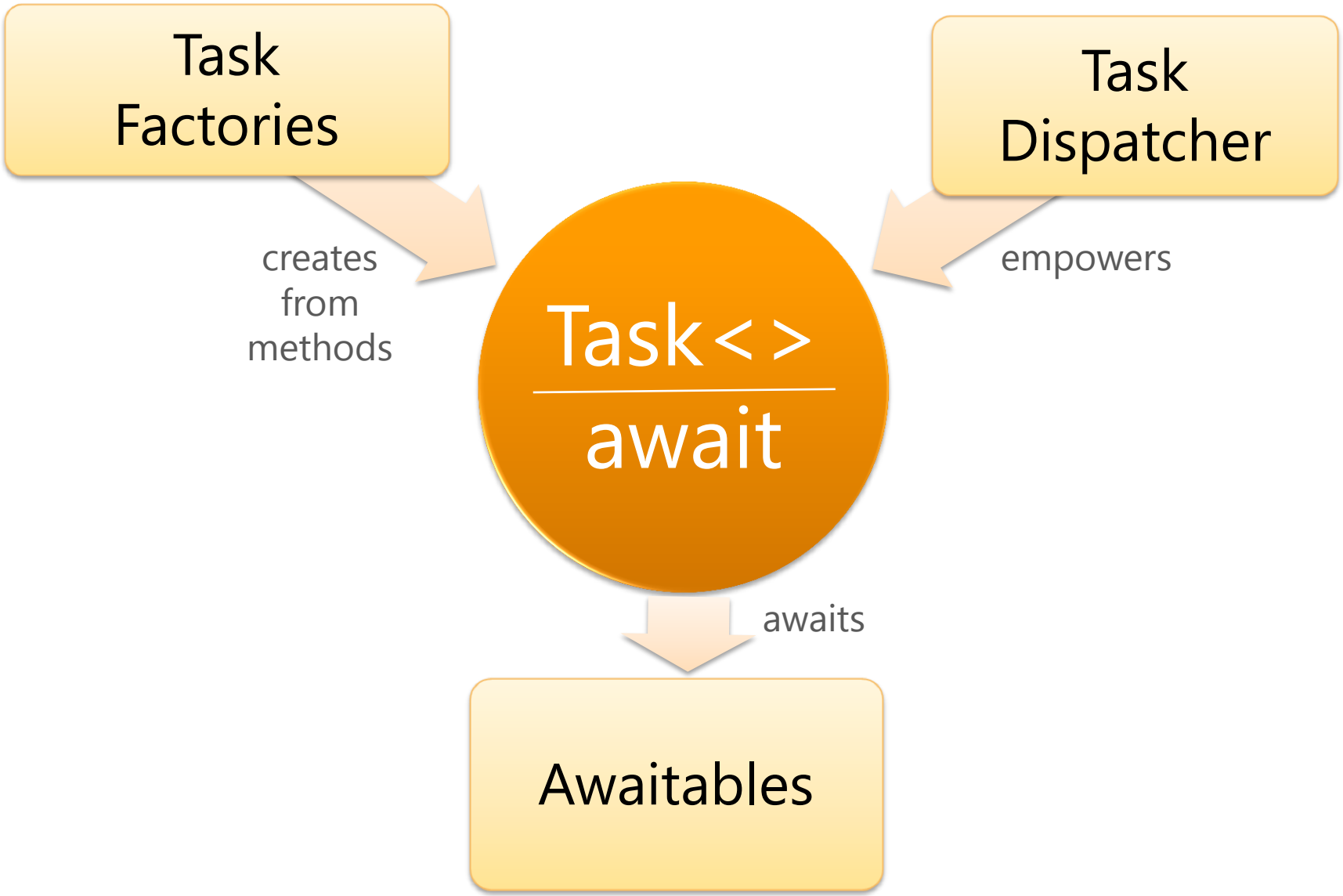


Example using await


```
Button.connect( bindAsTask( &MainView::convertIntoUrl, this ));

File saveCliprdToDisk();
QNetworkReply * uploadImage ( File );
QNetworkReply * requestUrl ( QNetworkReply * );
void put2clipboard(Qurl);

void convertIntoUrl() {
    File tmpFile = await boost::async( saveCliprdToDisk());
    QNetworkReply * uploadedFile = await uploadImage( tmpFile );
    QNetworkReply * fileUrl = await ( requestUrl, uploadedFile );
    put2clipboard( fileUrl->result());
}
```

Example using Task


```
Button.connect( bindAsTask( &MainView::convertIntoUrl, this ));

Task<File> saveCliprdToDiskAsync();
Task<QNetworkReply * > uploadImageAsync( File );
Task<QUrl> requestUrlAsync(QNetworkReply * );
void put2clipboard(QUrl);

void convertIntoUrl() {
    auto tmpFile = saveCliprdToDiskAsync();
    auto uploadedFile = uploadImageAsync( tmpFile );
    auto fileUrl = requestUrlAsync( uploadedFile );
    put2clipboard(fileUrl);
}
```


Task Factories
Task Dispatcher
creates from methods
empowers
Task<>
await
awaits
Awaitables

make_task

Creates an Task<R> from anything, that is callable

Starts the method immediatelly

bindAsTask

Creates an
std::function< Task<R> (...) >
from anything, that is callable

Start the method later, with invocation of the function object

taskify

```
auto taskify( method, placeholders::CALLBACK, Args…)
-> Task< std::tuple< P… > > ;
```

Starts the method immediatelly
Transforms the callback into an awaitable Task

Returns a Task with a `std::tuple`, containing the parameters of the `CALLBACK`.
`method` can be anything, that is callable
`CALLBACK` must be a function object.
`placeholders::EXCEPTION` also supported

Task<...>
boost::future<R>
QFuture<R>

Operation is already running

await directly
Store and await later
Create a Task from it and get result or await later

TaskDispatcher4StdThread
TaskDispatcher4QtThread
ThreadWithTasks

Creates an dispatcher for Tasks within current thread or creates a new thread with a dispatcher in it

Prerequisite to get Task<> working within a particallary thread!

Summary Usage

1. Instanciate suitable TaskDispatcher in your thread

2. Call async method as Task, using a Task Factory

3. Use await/Task with any Awaitable within this method

Example using Task


```
Button.connect( bindAsTask( &MainView::convertIntoUrl, this ));

Task<File> saveCliprdToDiskAsync();
Task<QNetworkReply * > uploadImageAsync( File );
Task<QUrl> requestUrlAsync(QNetworkReply * );
void put2clipboard(QUrl);

void convertIntoUrl() {
    auto tmpFile = saveCliprdToDiskAsync();
    auto uploadedFile = uploadImageAsync( tmpFile );
    auto fileUrl = requestUrlAsync( uploadedFile );
    put2clipboard(fileUrl);
}
```

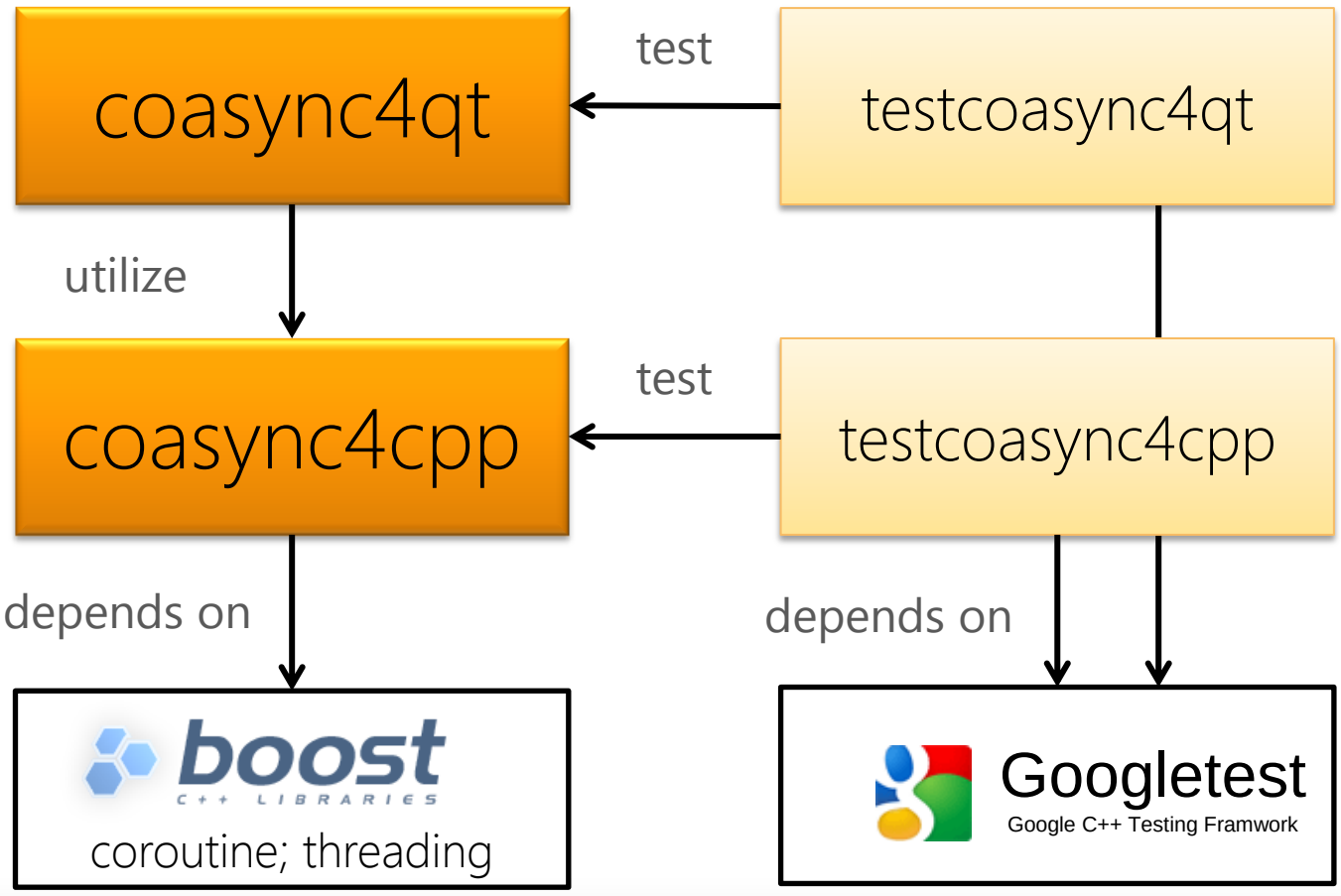
coasync4cpp
makes consuming async
APIs simple

Where to go from here?

Play around with testcoasync4cpp and testcoasync4qt to understand

https://github.com/helgebetzinger/coasync4cpp

coasync4cpp



https://github.com/helgebetzinger/coasync4cpp

pcvisit

Simple integration with legacy code

What can you expect from version 0.10?

More Awaitables

More Task Factories

QNetworkReply*

EnginioReply*

taskifyQtSignal

More Msg-Dispatchers

https://github.com/helgebetzinger/coasync4cpp

More Keywords

await_any, await_all, ..

Watch the project and stay tuned

Comment and report issues and requirements

Contribute added features or fixed bugs

coasync4cpp@pcvisit.com
https://github.com/helgebetzinger/coasync4cpp

No more callbacks!
Questions?

coasync4cpp@pcvisit.com
https://github.com/helgebetzinger/coasync4cpp