

# Flutter/Dart における FFI

**今日話すこと**

**dart:ffi の実装背景と課題**

**FFI ?**

# Foreign **f**unction **i**nterface

今回は C 呼び出しの話

# 自己紹介

@sensuikan1973



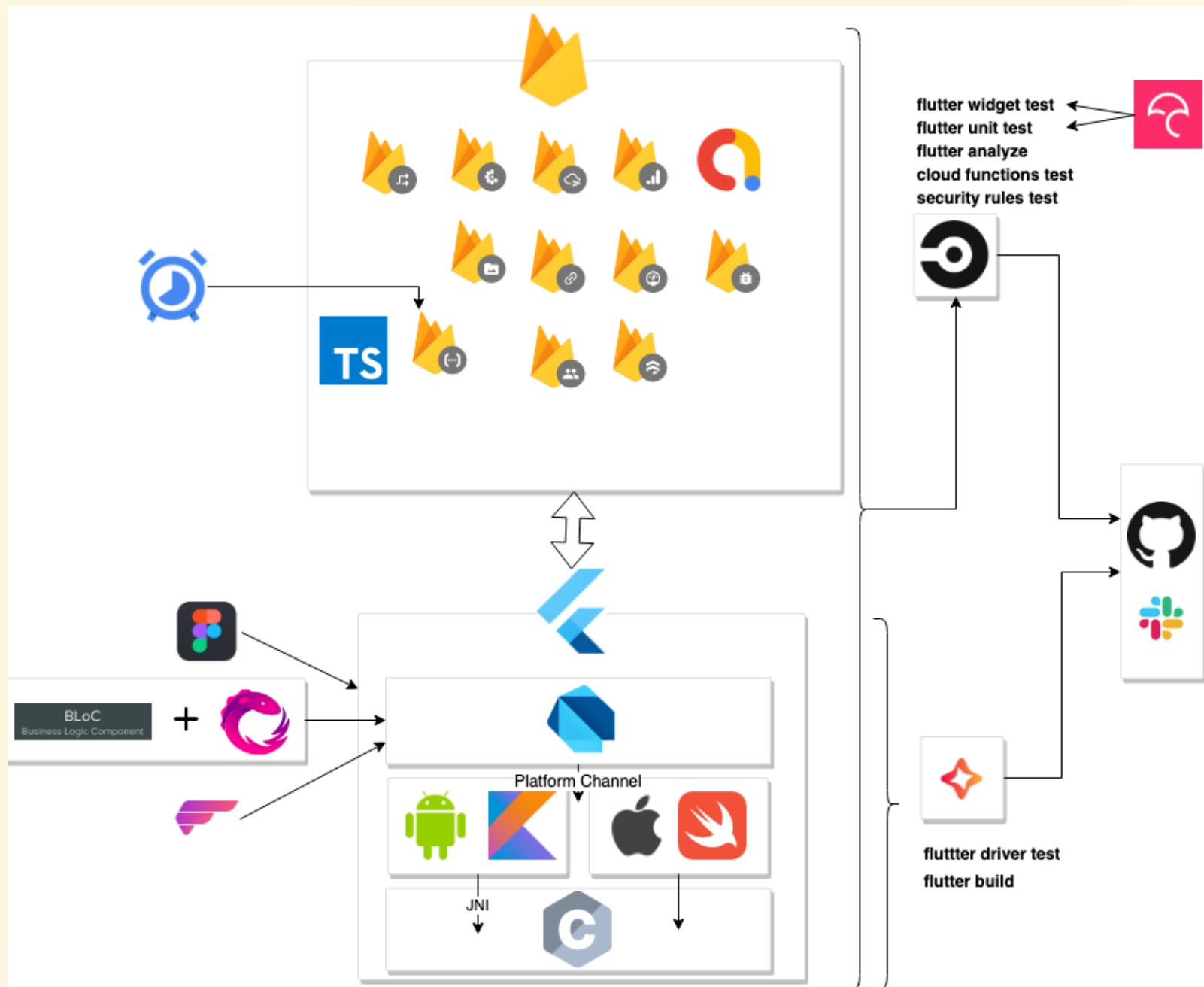
低レイヤの習熟度低いですが、頻繁に FFI と付き合う運命にあるので調べました



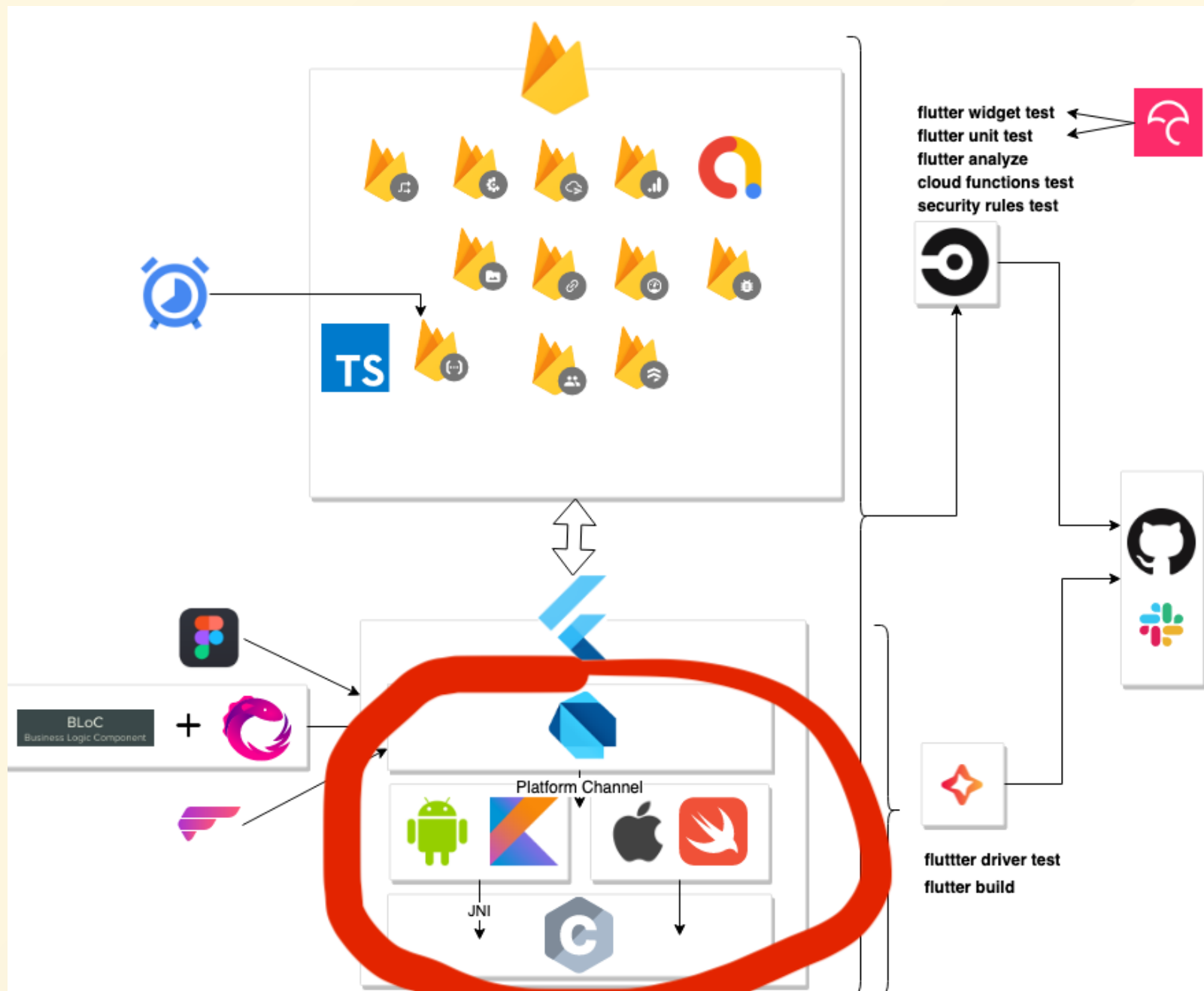


# お家で作ってるモノ





**オセロには常に C が必要**



# つらい...疲れた...重そう...

```
extern "C" void
    JNICALL
Java_com_done_sensuikan1973_othellode_LibEdax_nativeEdaxGetHintList(
    JNIEnv *env,
    jobject thiz,
    jint hintNum,
    jbooleanArray isBookMoveArray,
    jintArray scoreArray,
    jintArray bitPlaceArray
)
{
    auto hint_list = HintList();
    edax_hint(hintNum, &hint_list);
    jboolean *isBookMoveArrayPointer = env->GetBooleanArrayElements(isBookMoveArray, 0);
    jint *scoreArrayPointer = env->GetIntArrayElements(scoreArray, 0);
    jint *bitPlaceArrayPointer = env->GetIntArrayElements(bitPlaceArray, 0);
    const int MAX_HINT_NUM = 34;
    const int NOT_SEARCH_RESULT_BIT_PLACE = -1;
    for (int i = 0; i < MAX_HINT_NUM; i++){
        const auto hint = hint_list.hint[i];
        isBookMoveArrayPointer[i] = hint.book_move;
        scoreArrayPointer[i] = hint.score;
        bitPlaceArrayPointer[i] = hint.move;
        // 探索結果でない場合は bitPlace に -1 を入れて呼び出し側に伝える
        if (hint.pv->n_moves == 0) {
            bitPlaceArrayPointer[i] = NOT_SEARCH_RESULT_BIT_PLACE;
        }
    }
    env->ReleaseBooleanArrayElements(isBookMoveArray, isBookMoveArrayPointer, 0);
    env->ReleaseIntArrayElements(scoreArray, scoreArrayPointer, 0);
    env->ReleaseIntArrayElements(bitPlaceArray, bitPlaceArrayPointer, 0);
}
```

# 各言語の C 呼び出し

## 代表的なもの

言語	実装方法
Java	<a href="#">JNI</a> や <a href="#">JNA</a> , <a href="#">SWIG</a> を使う
Go	<a href="#">cgo</a> を使う
Python	<a href="#">ctypes</a> や <a href="#">cffi</a> を使う
Rust	<a href="#">extern キーワード</a> で容易に呼べる
Ruby	<a href="#">Ruby-FFI</a> を使う
Javascript	<a href="#">WebAssembly</a> を使う
Swift	<a href="#">そのままいける</a> し、 <a href="#">カスタム</a> も可能

**Dart は？**

# Dart から C を呼ぶ方法 (これまで)



# Native Extension

## Dart 側

```
library sample_hello;  
import 'dart-ext:sample_hello';  
void hello() native "Hello";
```

参考: [dart-lang sample extension](#)

## C++ 側 (一部省略)

```
DART_EXPORT Dart_Handle sample_hello_Init(Dart_Handle parent_library) {
    if (Dart_IsError(parent_library)) return parent_library;
    Dart_Handle result_code = Dart_SetNativeResolver(parent_library, ResolveName, NULL);
    if (Dart_IsError(result_code)) return result_code;
    return Dart_Null();
}

void hello(Dart_NativeArguments arguments) {
    Dart_EnterScope();
    printf("Hello\n");
    Dart_ExitScope();
}

Dart_NativeFunction ResolveName(Dart_Handle name, int argc, bool* auto_setup_scope) {
    if (!Dart_IsString(name) || auto_setup_scope == NULL) return NULL;
    Dart_EnterScope();
    const char *cname;
    Dart_StringToCString(name, &cname);
    Dart_NativeFunction result = NULL;
    if (strcmp(cname, "hello") == 0) result = hello;
    Dart_ExitScope();
    return result;
}
```

- 👉 深いレベルで拡張可能
- 👉 都度 `ResolveName` する

## わかりやすく例をもう一個

```
void isEven(Dart_NativeArguments arguments) {
    Dart_EnterScope();
    Dart_Handle arg1 = Dart_GetNativeArgument(arguments, 0);
    int64_t input;
    if (Dart_IsError(Dart_IntegerToInt64(arg1, &input)))
    {
        Dart_ThrowException(Dart_NewStringFromCString("Error だよ"));
    }
    Dart_SetReturnValue(arguments, Dart_NewBoolean(input % 2 == 0));
    Dart_ExitScope();
}
```

👉 引数と返り値の型情報が静的に定義されていない

**さて、Flutter では？**

**現状、Swift/Objective-C, Kotlin/Java  
を経由する必要がある**

# Support integrating with C/C++ in plugin framework #7053



jtrunick opened this issue on 29 Nov 2016 · 141 comments



jtrunick commented on 29 Nov 2016 • edited by mit-mit ▾



It would be nice to have an example of calling C/C++ code, or at least how to build native code along with a Flutter app. This may purely a Gradle question, but its not clear to someone that's not an expert on Gradle (for example, me), how to pull this off.

Admin comment: Please see [dart-lang/sdk#34452](#) for current status and additional information



553



52



68



14



117



21

Ass



Lab

de

eng

p: f

plu

sev

**たくさんの 👍 の思いは？**



# ① 既存ソフトをより統合しやすくしてほしい

- **大量のグルーコードがづらい**
- **低オーバーヘッドがいい**

**SQLite**

**Realm**

**OpenCV**

**crypto, ssh ... libraries**

などが具体例として挙げられている

## ② 大量のデータを効率よく出し入れしたい

なお、Dart 2.4 から [TransferableTypedData](#) が使用できるようになったので、ある程度はそれで間に合いそう

**こういう要望にどう応えるか？**

**「Native Exstention でいいんじゃないの...?」**

# Support for Dart Extensions #2396

**Closed**

eseidelGoogle opened this issue on 4 Mar 2016 · 9 comments



eseidelGoogle commented on 4 Mar 2016

Contributor

+ 😊 ...

<https://www.dartlang.org/articles/native-extensions-for-standalone-dart-vm/>

We've had at least one request for this. I suspect it's implemented entirely in the `dart` CLI.

My understanding is it's just a bit of code to map `dart-ext:` urls to making a `dlopen` call and passing the symbols off to the VM. @johnmccutchan

I'm mostly seeking to document how we'd do this in this bug. It's not clear if this is generically useful.

👍 14

Flutter/Dart における Dart->C をどう実現するか？



⇒ Dart VM FFI Vision に理由が述べられていた



## 【理由 1】

# 名前ベースの API

```
// dart-lang/sdk/runtime/include/dart_api.h より引用  
DART_EXPORT DART_WARN_UNUSED_RESULT Dart_Handle  
Dart_SetField(Dart_Handle container, Dart_Handle name, Dart_Handle value);
```

👉 名前解決がキャッシュされない

👉 AOT コンパイラに厳しい

(最悪の場合を想定したり、手動でアノテーションを付けてまわったりしないといけない)

## 【理由 2】

# Reflective Marshaling は効率良くない

```
void isEmailAddress(Dart_NativeArguments arguments)
```

```
void arguments 🙄
```

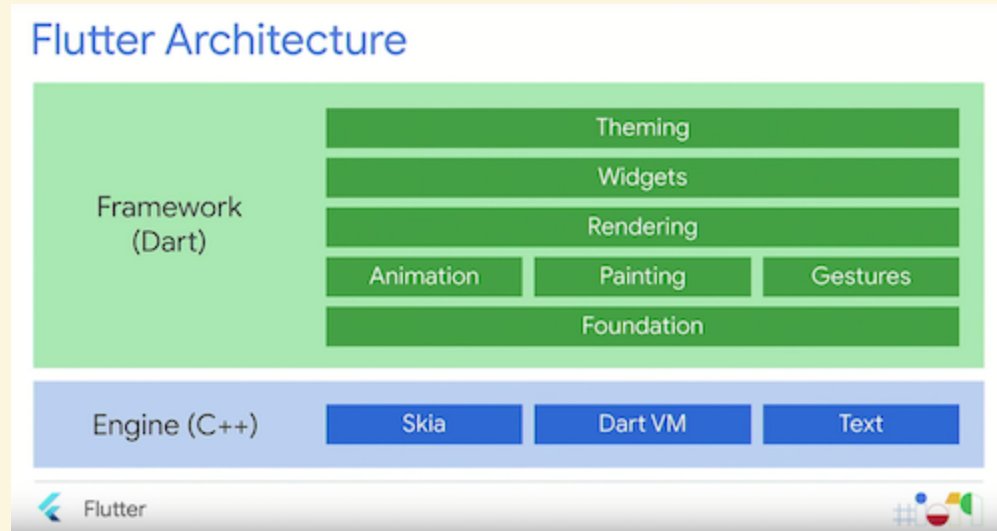
⇒ 引数/返り値が静的に型付けされた上での Marshaling の方が効率良い

⇒ その点は FFI が優れている

そこで、 dart : ffi 👍

<https://github.com/dart-lang/sdk/tree/master/sdk/lib/ffi>

# Google I/O'19 でも言及あり



“  
**We are working on a new foreign function interface.  
This should help you reuse existing C and C++ code,  
which is important for some critical stuff**  
”

## ちなみに

“ we expect that moving Flutter Engine from C API to FFI should significantly reduce overheads associated with crossing the boundary between Dart and native code ”

**どう使えるのか？**



```
import "dart:ffi" as ffi;
import 'dart:io' show Platform;

void main() {
  final libHelloWorld = ffi.DynamicLibrary.open("./libHelloWorld.dylib");
  final helloWorld = libHelloWorld.lookupFunction
    <ffi.Void Function(), void Function()>("helloWorld");

  helloWorld();
}
```

[https://github.com/sensuikan1973/Dart\\_FFI\\_Hello\\_World](https://github.com/sensuikan1973/Dart_FFI_Hello_World)

# **ちなみに、先週、 Flutter stable 版に入った**

**(Android のみで試験的に触れる)**



# どういう構成になるのか

App Developer	Package Developer			Dart VM Team	Native Library Developer
Flutter App  (Imports package)	Package API  (Does not expose dart:ffi)	Package Implementation  (Code which converts C++ abstractions into Dart abstractions)	Bindings	dart:ffi	Native Library
Dart				C / C++	

👉 Bindings:

```
final helloWorld = libHelloWorld.lookupFunction<ffi.Void Function(), void Function()>
("helloWorld");
```

みたいなものを定義するレイヤーのこと

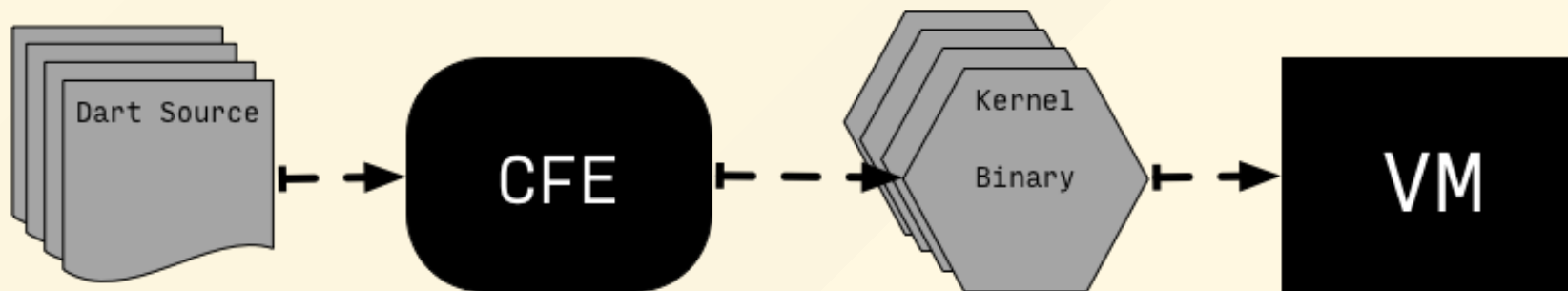
# 課題をいくつか紹介

# 1: 例外を拾えない

⇒ C レイヤーを追加実装する

App Developer	Package Developer			Dart VM Team	Package Developer	Native Library Developer
Flutter App  (Imports package)	Package API  (Does not expose dart:ffi)	Package Implementation  (Code which converts C++ abstractions into Dart abstractions)	Bindings	dart:ffi	Glue code  (Code which takes care of things such as C++ exceptions)	Native Library
Dart				C / C++		

## 2: CFE への追加実装




補完や静的解析を行うために、  
**CFE (Common Front-End)** への追加実装が必要。

\*Dart2 VM からは、生のソースから Dart を直接実行できず、CFE によって生成された [Kernel Binary\(dill\)](#) を与える必要がある


### 3: サポート対象のプラットフォーム

待ちきれない人がスケジュールを聞く  
⇒ 具体的なスケジュールは示せない。待つて。



**racer161** commented 6 days ago


Second this. Flutter makes sense for my project with FFI support for iOS but not without it. Can we get an ETA?



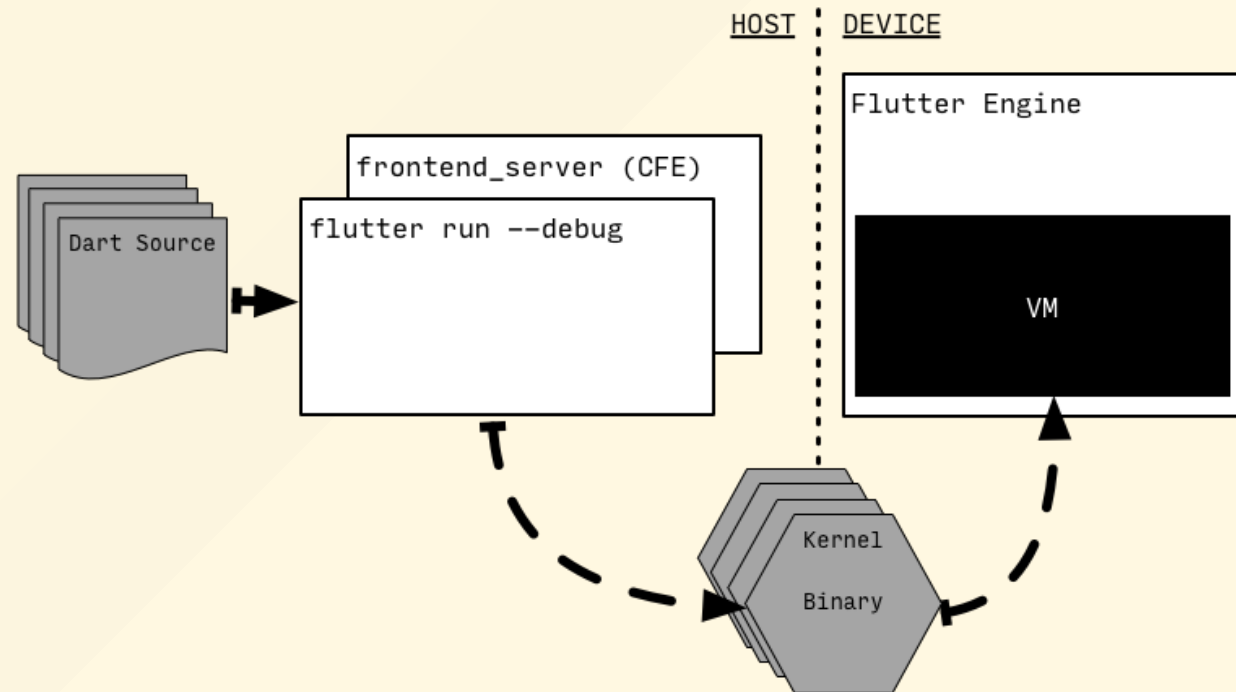
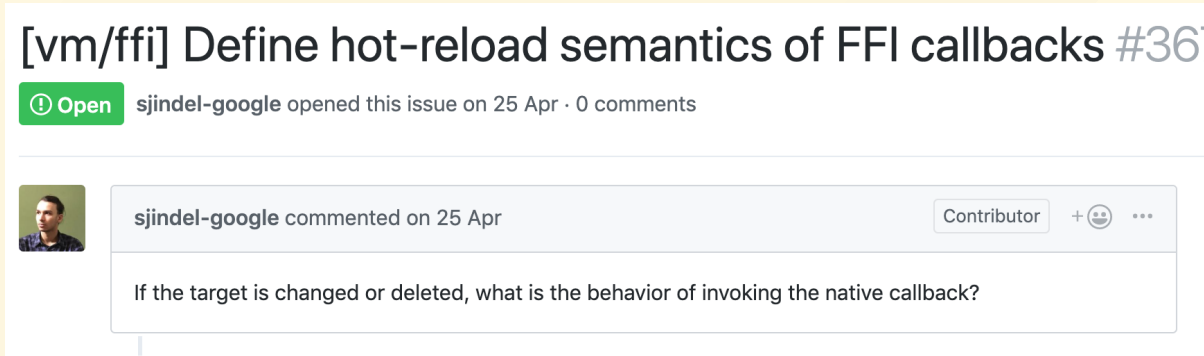
**mraleph** commented 5 days ago

Contributor

Sorry, usually we don't provide ETAs or concrete timelines. The work on FFI is going full steam and we hope to have all pieces necessary for Flutter developers to be able to develop apps using FFI on all supported platforms at some point in the near future.

 1

## 4: HotReload 下での callback の挙動は..?



## その他タスクの詳細は [Dart VM FFI projects](#) を参照

正直に言いますと、低レイヤの勉強不足で、  
あまり理解できてないものが多い...



詳しい方は是非 [dart:ffi](#) に FB を送りま  
しょう 👍

**ありがとうございました**

# リンク一覧

- [Dart VM FFI Vision](#)
  - [Introduction to Dart VM](#)
  - [Design and implement Dart VM FFI](#)
  - [Flutter Support integrating with C/C++ in plugin framework](#)
  - [Native extensions for the standalone Dart VM](#)
  - [Support for Dart Extensions](#)
  - [dart:ffi resolve outstanding design decisions](#)
- [C & C++ interop using FFI](#)
  - [sdk/lib/ffi/](#)
  - [Dart Native platform](#)
  - [dart:ffi sqllite sample](#)
- [The Engine architecture](#)
  - [Writing custom platform-specific code](#)
  - [Custom Flutter Engine Embedders](#)
- [Language features for FFI](#)
- [sensuikan1973/flutter-ffi-slide](#)
- [sensuikan1973/Dart FFI Hello World](#)