Porting LLDB

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Outline

- Introduction
- A Typical Debug Session
- LLDB Architecture
- Porting LLDB
- Roles of Plugins
- Questions

Introduction

- LLVM Debugger
- Open Sourced in 2010
- Written in C++
- Small but helpful community
- Status
  - Default debugger for xcode
  - Linux and FreeBSD ports are working
  - Package available in many distros.
  - Windows support is coming online

Example Session

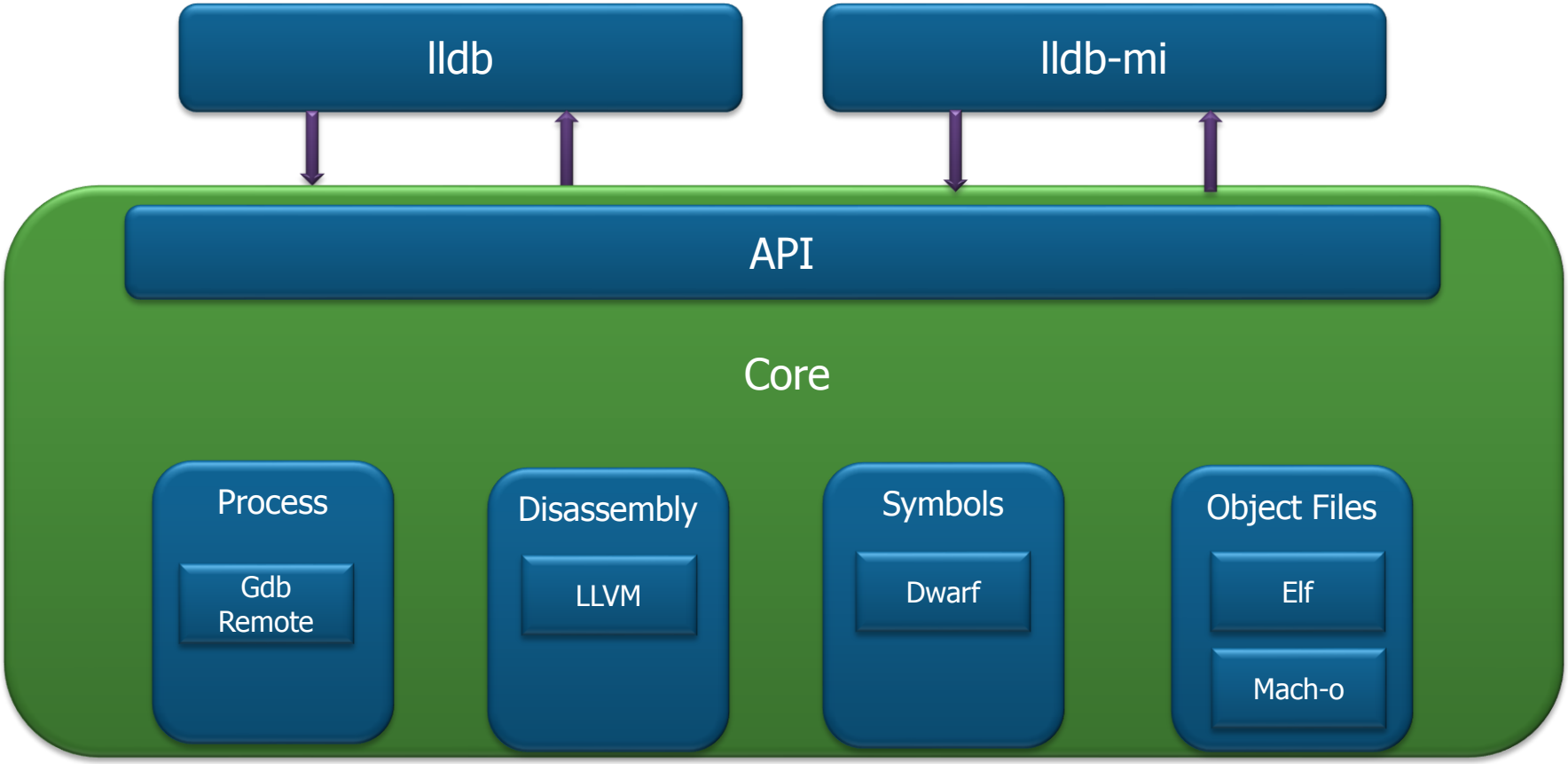
```
 > lldb hello
(lldb) target create "hello"
Current executable set to 'hello' (x86_64).
(lldb) b main
Breakpoint 1: where = hello`main + 4 at hello.c:5, address = 0x0000000000400531
(lldb) r
Process 7093 launching
Process 7093 launched: '/home/abidh/demos/hello' (x86_64)
Process 7093 stopped
* thread #1: tid = 7093, 0x0000000000400531 hello`main + 4 at hello.c:5, name = 'hello', stop reason = breakpoint 1.1
    frame #0: 0x0000000000400531 hello`main + 4 at hello.c:5
   2               int counter = 10;
   3               int main(void)
   4               {
-> 5                           printf("Hello World!");
   6                           counter++;
   7                           return 0;
   8               }
(lldb) p counter
(int) $0 = 10
(lldb) bt
* thread #1: tid = 7093, 0x0000000000400531 hello`main + 4 at hello.c:5, name = 'hello', stop reason = breakpoint 1.1
  * frame #0: 0x0000000000400531 hello`main + 4 at hello.c:5
    frame #1: 0x00007ffff7a35ec5 libc.so.6`__libc_start_main + 245
    frame #2: 0x0000000000400469 hello
```

So a debugger needs to …

- Read the object file
- Find symbols information if available
- Provide execution control
  - run, stop, break
- Provide visibility into the program
  - Variables and expressions
  - Register, memory, disassembly
  - Target function call
  - Dynamic Objects
  - OS Awareness

Architecture

- Provides a C++ API which can be used by various clients



Life cycle of a Plugin

- PluginManager
- Initialize
  - Register itself with the PluginManager
- Find a Plugin to do something
  - Call PluginManager::FindPlugin with enough information
- CreateInstance
- Overload required functions
- Terminate
  - Unregister itself from PluginManager

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ObjectFile

- Chances are that your file is already supported
  - Elf, mach-o, PE-coff
- Creation
  - If able to handle a given object file
- CreateSections
  - Figure out how many sections are in this object file
- ReadSectionData
  - Read data from a given section
- Other useful information
  - ByteOrder, AddressSize, Architecture
  - EntryAddress

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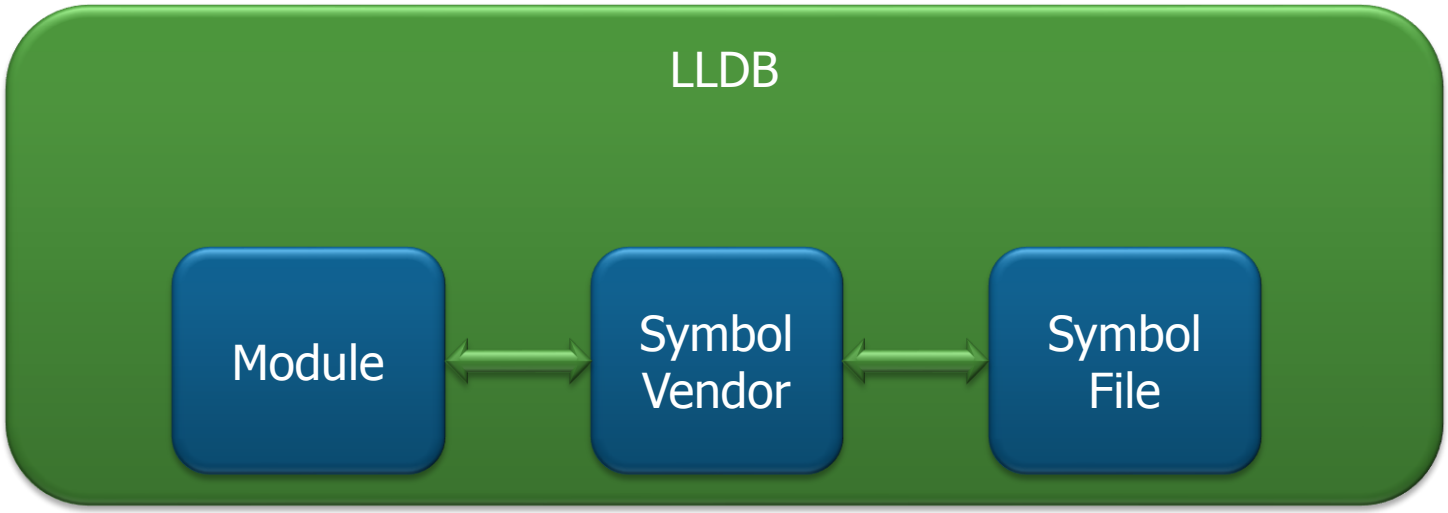
SymbolFile & SymbolVendor

- SymbolFile
  - Dwarf
- SymbolVendor
  - Controls the process of finding symbols
  - Separate or multiple symbols file



Example Session

(lldb) target module dump line-table hello.c

Line table for /home/abidh/demos/hello.c in `hello

0x000000000040052d: /home/abidh/demos/hello.c:4

0x0000000000400531: /home/abidh/demos/hello.c:5

0x0000000000400540: /home/abidh/demos/hello.c:6

0x000000000040054f: /home/abidh/demos/hello.c:7

0x0000000000400554: /home/abidh/demos/hello.c:8

0x0000000000400556: /home/abidh/demos/hello.c:8

(lldb) target module dump sections

Dumping sections for 3 modules.

Sections for '/home/abidh/demos/hello' (x86_64):

SectID	Type	Load Address	File Off.	File Size	Flags	Section Name
0x00000001	regular		0x00000000	0x00000000	0x00000000	hello.
0x00000002	regular	[0x0000000000400238-0x0000000000400254)	0x00000238	0x0000001c	0x00000002	hello..interp
0x00000003	regular	[0x0000000000400254-0x0000000000400274)	0x00000254	0x00000020	0x00000002	hello..note.ABI-tag
0x00000004	regular	[0x0000000000400274-0x0000000000400298)	0x00000274	0x00000024	0x00000002	hello..note.gnu.build-id

….

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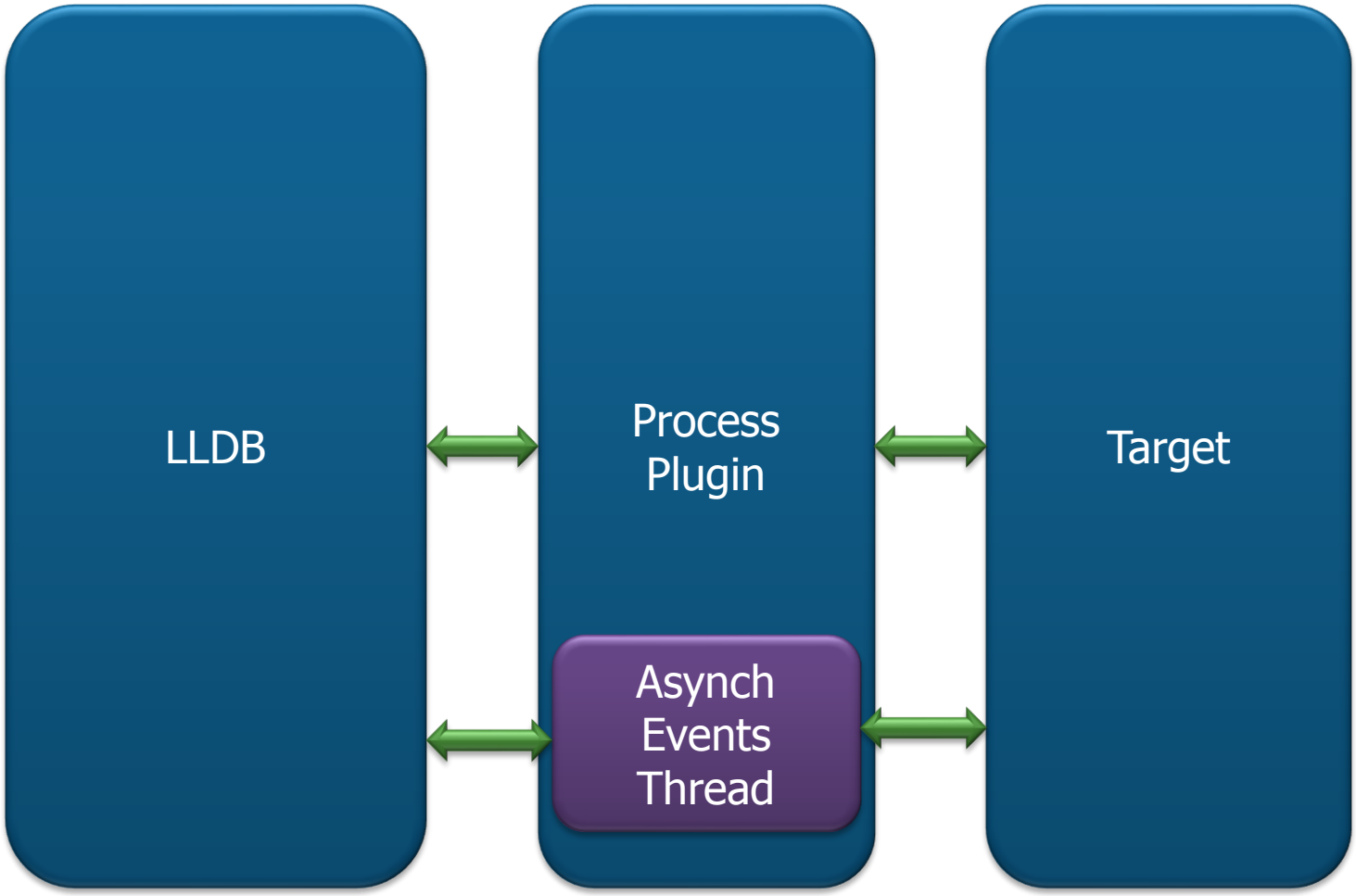
Process Plugin

- What already there
  - Linux
  - FreeBSD
  - Window
  - Gdb-remote
  - Elf-core
  - …
- If your target is not one of these
  - Is remote debugging an option for you

Process Plugin

- Selection
- Major Components
  - Process
    - Attach, connect
    - Read/write memory
    - Breakpoint
    - Run/stop
  - Thread
    - Stop Reason
    - Target specific step operation
    - GetUnwinder
  - Register Access
    - Recognize PC, SP, FP

Process Plugin



Process Plugin

- WillLaunch, DoLaunch
- DoConnect
- WillResume, DoResume
- WillHalt, DoHalt
- EnableBreakpointSite, DisableBreakpointSite
- DoReadMemory, DoWriteMemory
- DoAllocateMemory
- UpdateThreadList
- GetStatus
- DoDestroy

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  - **OS Awareness**

Program Visibility

- Register
- Memory
  - Done by Process Plugin
- Disassembler
  - LLVM disassembler
- Stack
  - Good debug information
  - UnwindAssembly Plugin
- Expressions
  - Clang integration

Program Visibility

- Target Function Call
  - ABI Plugin
- DynamicLoader
  - Shared Objects
  - Step over function trampoline
  - TLS
- OperatingSystem Plugin
  - OS awareness

Misc Stuff

- ArchSpec
  - Provides target description
- Elf header
  - Handles your architecture
- Thread::Unwinder
  - Select default unwinder
- Add your Plugins in the build
- Call your Initialize/Terminate functions
- Test cases
  - Add test cases specific to your architectures

Hurray …

- Read the object file
- Find symbols information if available
- Provide execution control
  - run, stop, break
- Provide visibility into the program
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QUESTIONS