LLVM – An Introduction

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LLVM – An Introduction

LLVM Vision and Approach

- Primary mission: build a set of modular compiler components:
  - Reduces the time & cost to construct a particular compiler
    - A new compiler = glue code plus any components not yet available
  - Components are shared across different compilers
    - Improvements made for one compiler benefits the others
  - Allows choice of the right component for the job
    - Don’t force “one true register allocator”, scheduler, or optimization order
- Secondary mission: Build compilers that use these components
  - ... for example, an amazing C compiler

LLVM Umbrella of Projects

- LLVM Language independent optimizer and code generator
  - Many optimizations, many targets
  - Not a compiler by itself
- Clang C/C++/Objective-C front-end
  - Designed for speed, reusability, compatibility with GCC
- MC: Machine Code slicing and dicing
  - Assemblers, disassemblers, object file processing
- LLDB – LLVM Debuggers
  - Native debugger that reuses Clang's parser, LLVM JIT, MC disassemblers
- libc++: C++ standard runtime library
  - Full support for C++'0x

LLVM Code Generator Highlights

Approachable C++ code base, modern design, easy to learn

- Strong and friendly community, good documentation

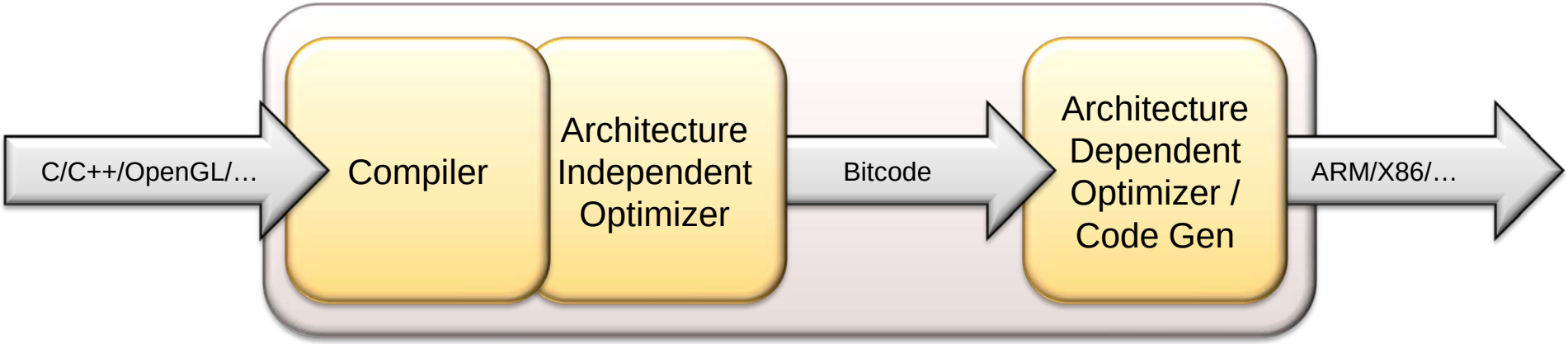
Language and target independent code representation

- Very easy to generate from existing language front-ends
- Text form allows you to write your front-end in perl if you desire

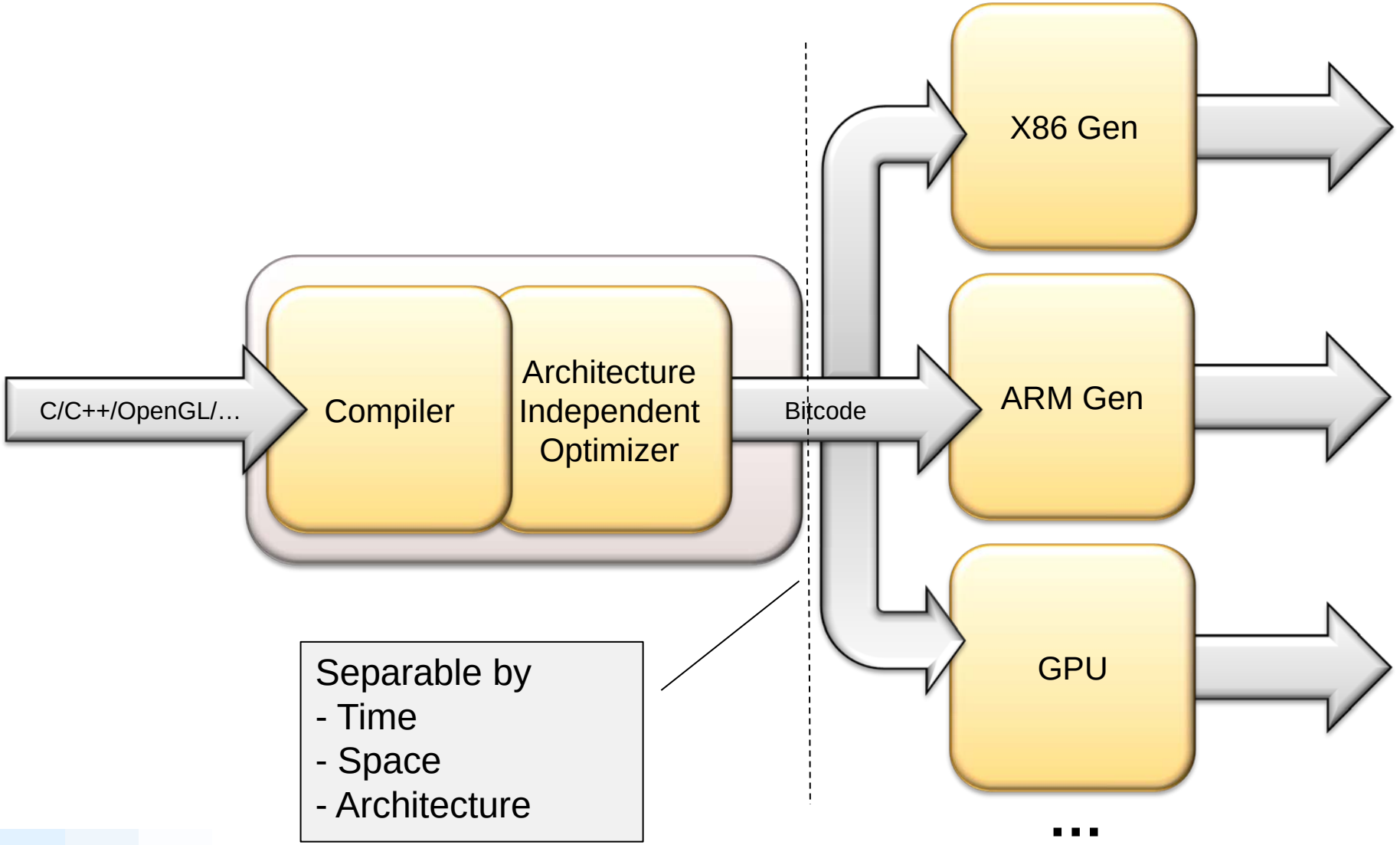
Modern code generator

- Easily retargetable to new chips
- Many popular targets supported:
  - X86, ARM, PowerPC, SPARC, Alpha, MIPS, Blackfin, CellSPU, MBlaze, MSP430, XCore, etc.
- Supports both JIT and static code generation

LLVM – Static Compiler Configuration



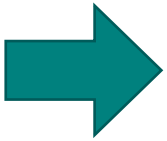
LLVM – JIT Configuration



Colorspace Conversion

- Code to convert from one color format to another:
  - e.g. BGRA 444R to RGBA 8888
  - Hundreds of combinations, importance depends on input

```
for each pixel {
  switch (infmt) {
  case RGBA5551:
    R = (*in >> 11) & C
    G = (*in >> 6) & C
    B = (*in >> 1) & C
  ... }
  switch (outfmt) {
  case RGB888:
    *outptr = R << 16 |
              G << 8 ...
  }
}
```



Run-time specialize

```
for each pixel {
  R = (*in >> 11) & C;
  G = (*in >> 6) & C;
  B = (*in >> 1) & C;
  *outptr = R << 16 |
            G << 8 ...
}
```

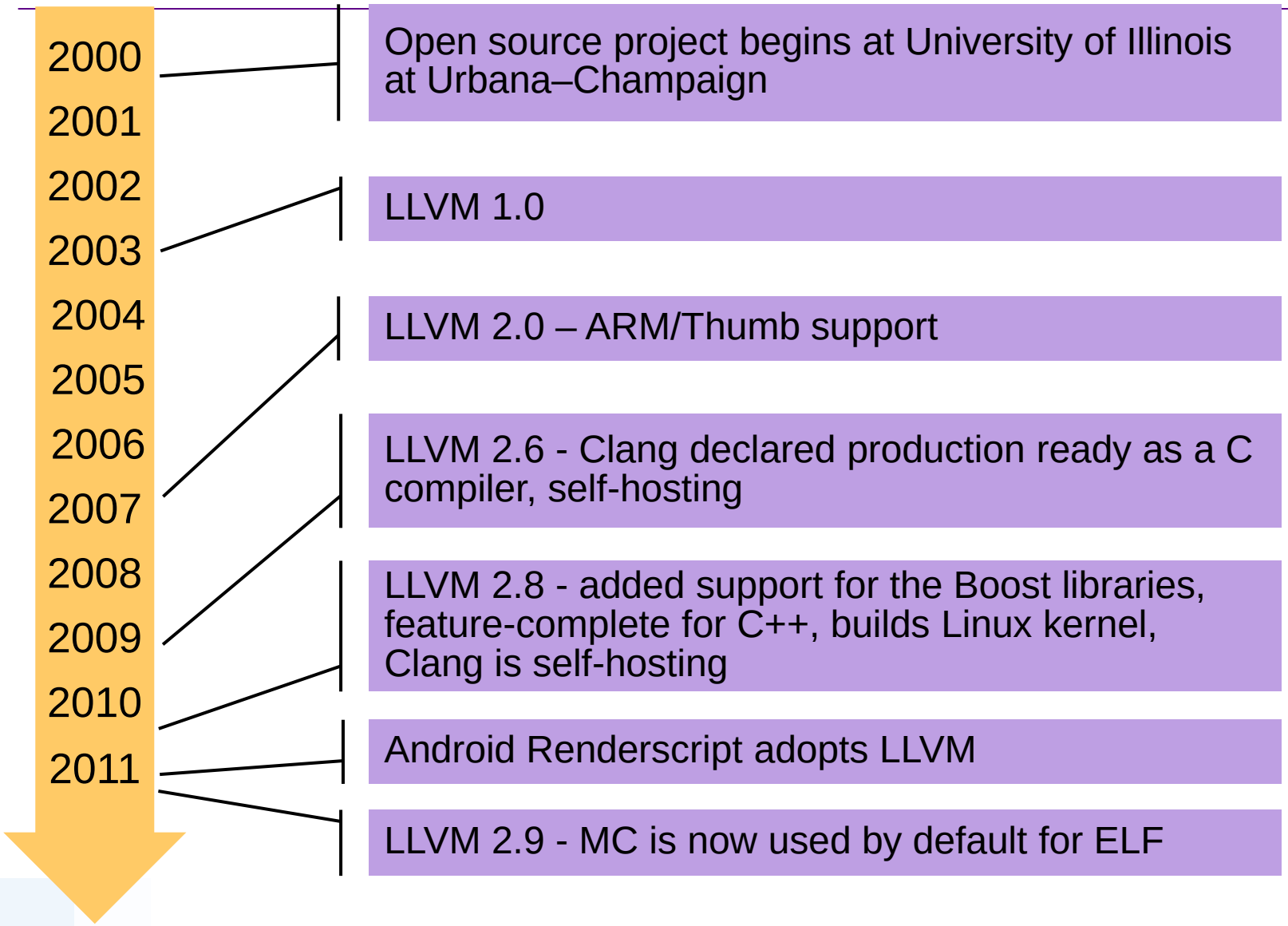
Compiler optimizes shifts and masking

- Speedup depends on src/dest format:
  - 5.4x speedup on average, 19.3x max speedup: (13.3MB/s to 257.7MB/s)

LLVM Growing Impact

- Solid technology base for tool evolution and code generation for the next decade
- Provides an excellent common ground for collaboration
  - Open source
  - Vibrant ecosystem
  - Release cadence of approximately 6 months
- LLVM has been adopted in important technologies and will become a standard component for Linux platforms
  - Chrome PNaCl
  - Android Renderscript
  - OpenCL – discussions on adopting LLVM IR
  - Graphics pipelines – prevalent
- LLVM will start shipping in volume on Linux mobile devices this year with Android Honeycomb

LLVM Timeline



Further Adoption

- Active investigations in other system areas adopting LLVM
- Potential to use LLVM for complete system builds
  - Reduce build complexities
  - Leverage bug fixes and optimizations
- LLVM is not quite ready for production Linux builds
  - Continued improvements in generated code performance
  - Further integration with Linux ecosystem
- If interested, join the LLVM community
  - LLVM.org
  - Next developers meeting in the fall

Agenda

Session	Speaker	Start	Duration
Introduction to LLVm	David Kipping	9:00	0:20
LLVM Use Cases - PNaCl	David Sehr	9:20	0:30
LLVM Use Cases - LLVM for RenderScript and Pixelflinger	Shih-wei Liao	9:50	0:30
Benchmarking & Continuous Testing of LLVM	Michael Larabel	10:20	0:30
Break		10:50	0:15
Building Linux with LLVM	Bryce Lelbach	11:05	0:30
LLVM Ecosystem	Mark Mitchell	11:35	0:35

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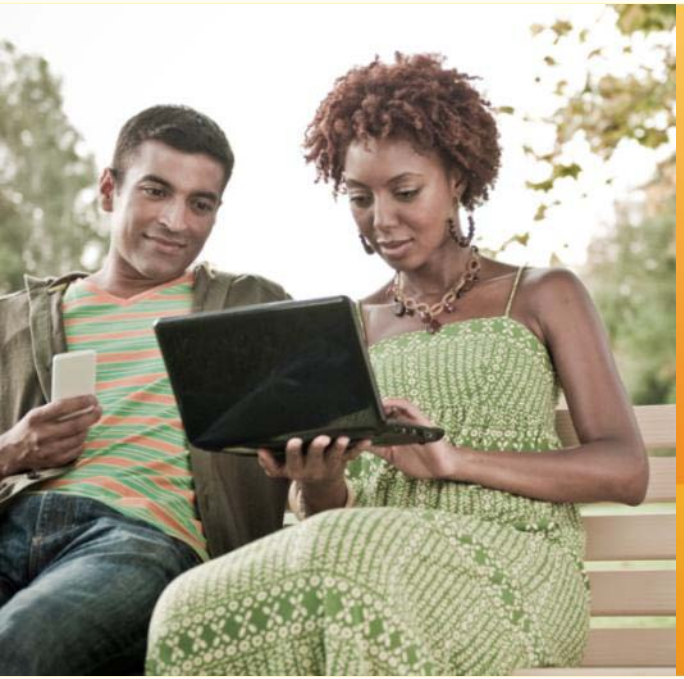

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