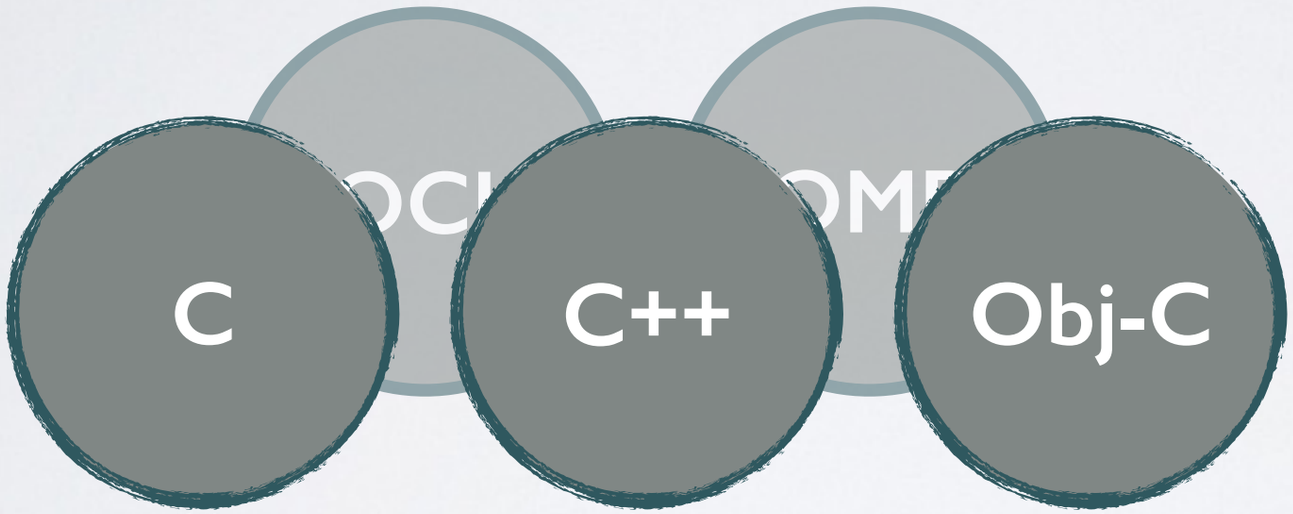
clang

reinventing the compiler



NUANTI

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appvm™

http://www.nuanti.com

Overview

- What can we achieve going *beyond compilation*?
- Why are we compelled to *invent a better wheel*?
- How can we make everyday life better for coders?
- Could the compiler itself become an instrument for wider *social change*?

Clang in a Nutshell

clang
driver

clang-cl
driver

clang
frontend

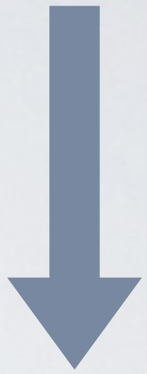
LLVM
backend

lld
linker

Lex
tokenization and preprocessing

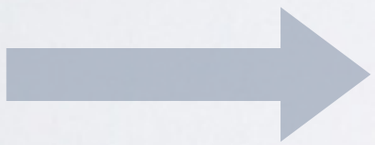
Parse
semantic analysis

clang frontend "lowering"



Sema
semantic analysis

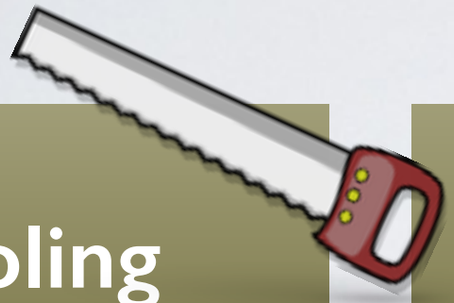
Analyzer
static analysis



AST
syntax tree

CodeGen
to LLVM IR

```
Analysis ARCMigrate AST ASTMatchers Basic CodeGen Driver Edit Format Frontend
FrontendTool Headers Index Lex Parse Rewrite Sema Serialization StaticAnalyzer Tooling
```



Tooling
build-your-own

CIndex
indexing engine

libclang
stable C API

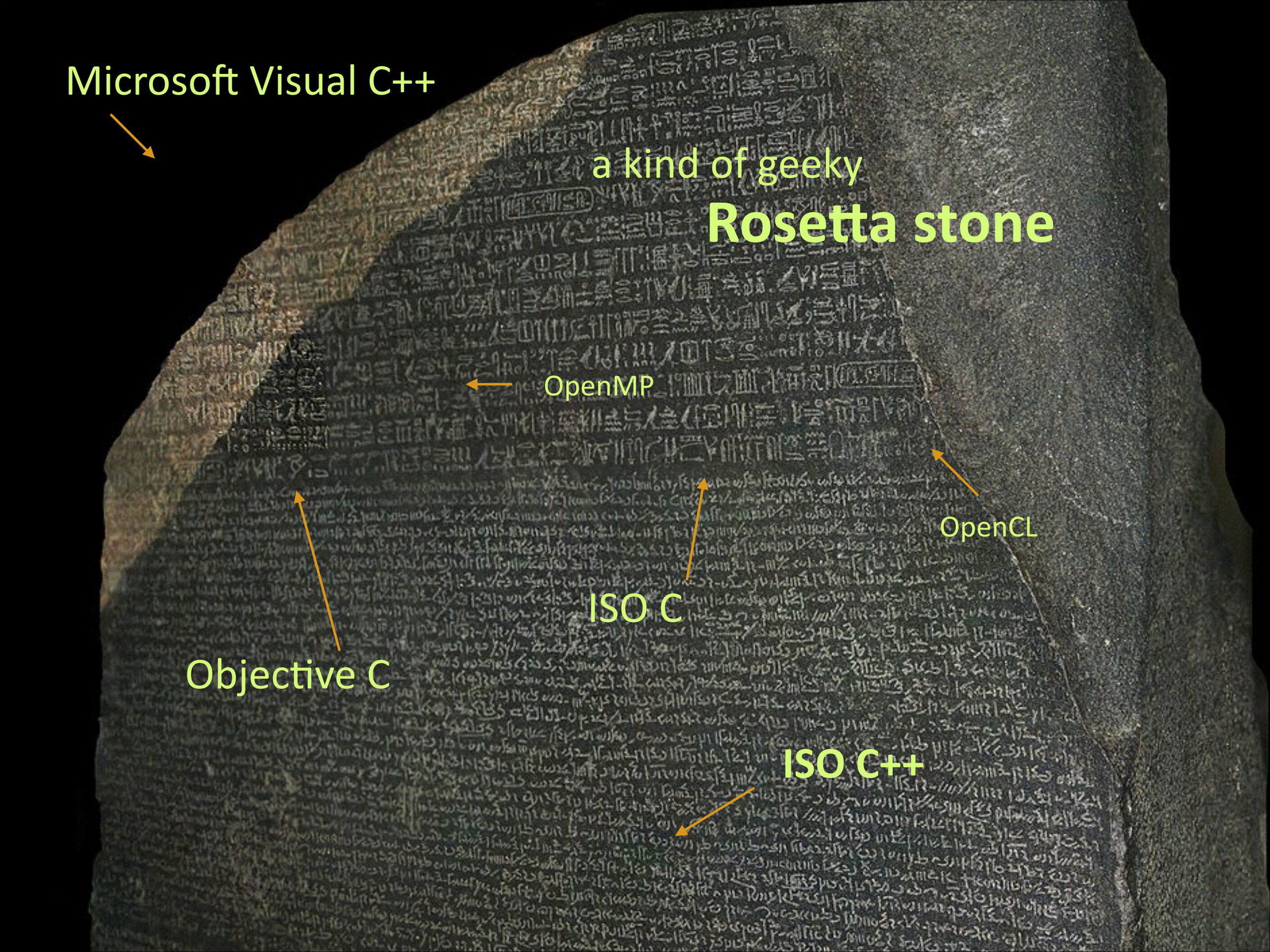
Rewrite
& other utilities

Plugins
& frontend passes

Why invent a better wheel?

MSVC support is coming. But why are we even doing this?

DEVELOPERS
DEVELOPERS
DEVELOPERS
DEVELOPERS

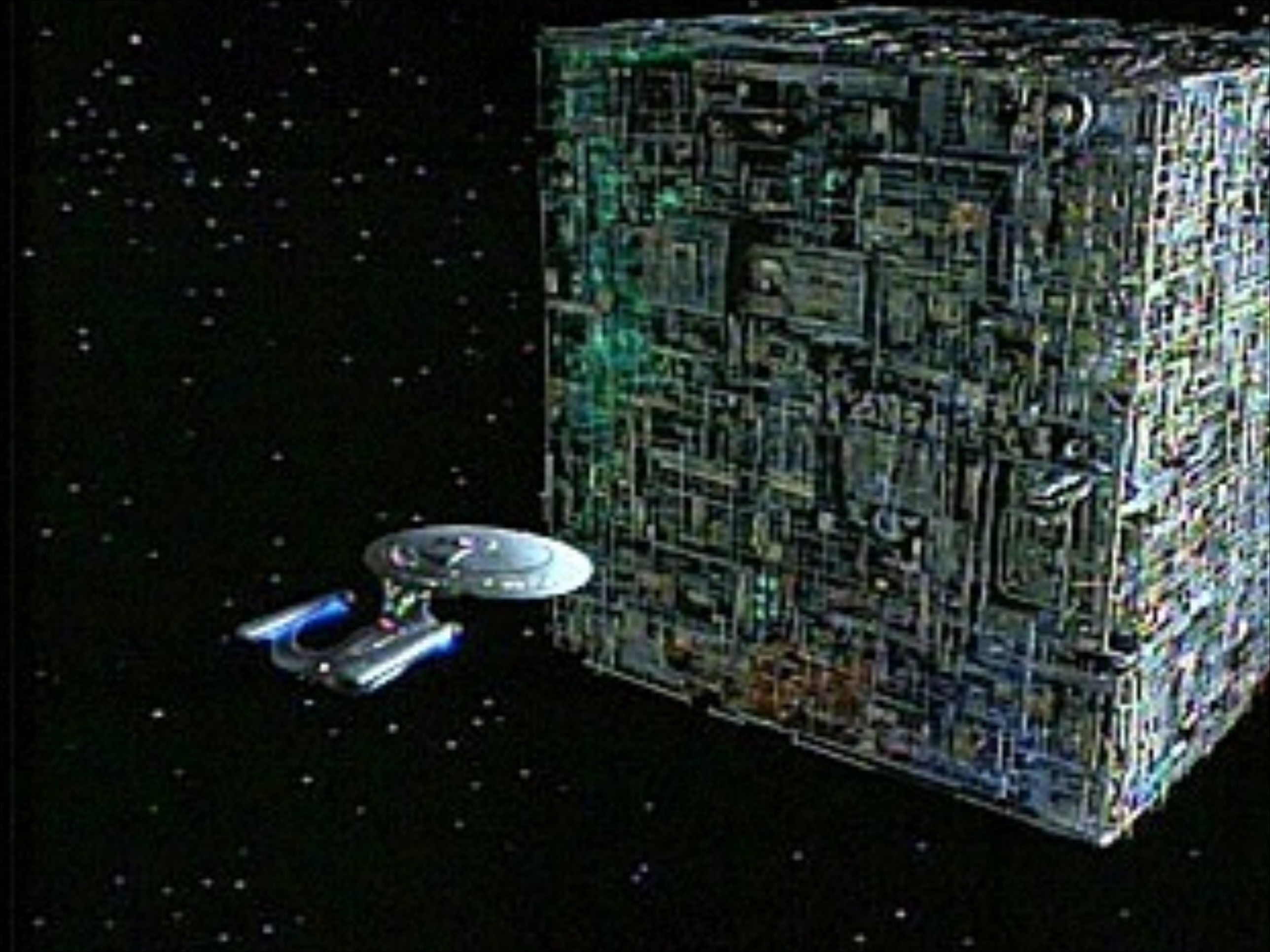

Microsoft Visual C++
a kind of geeky
Rosetta stone
OpenMP
OpenCL
ISO C
Objective C
ISO C++

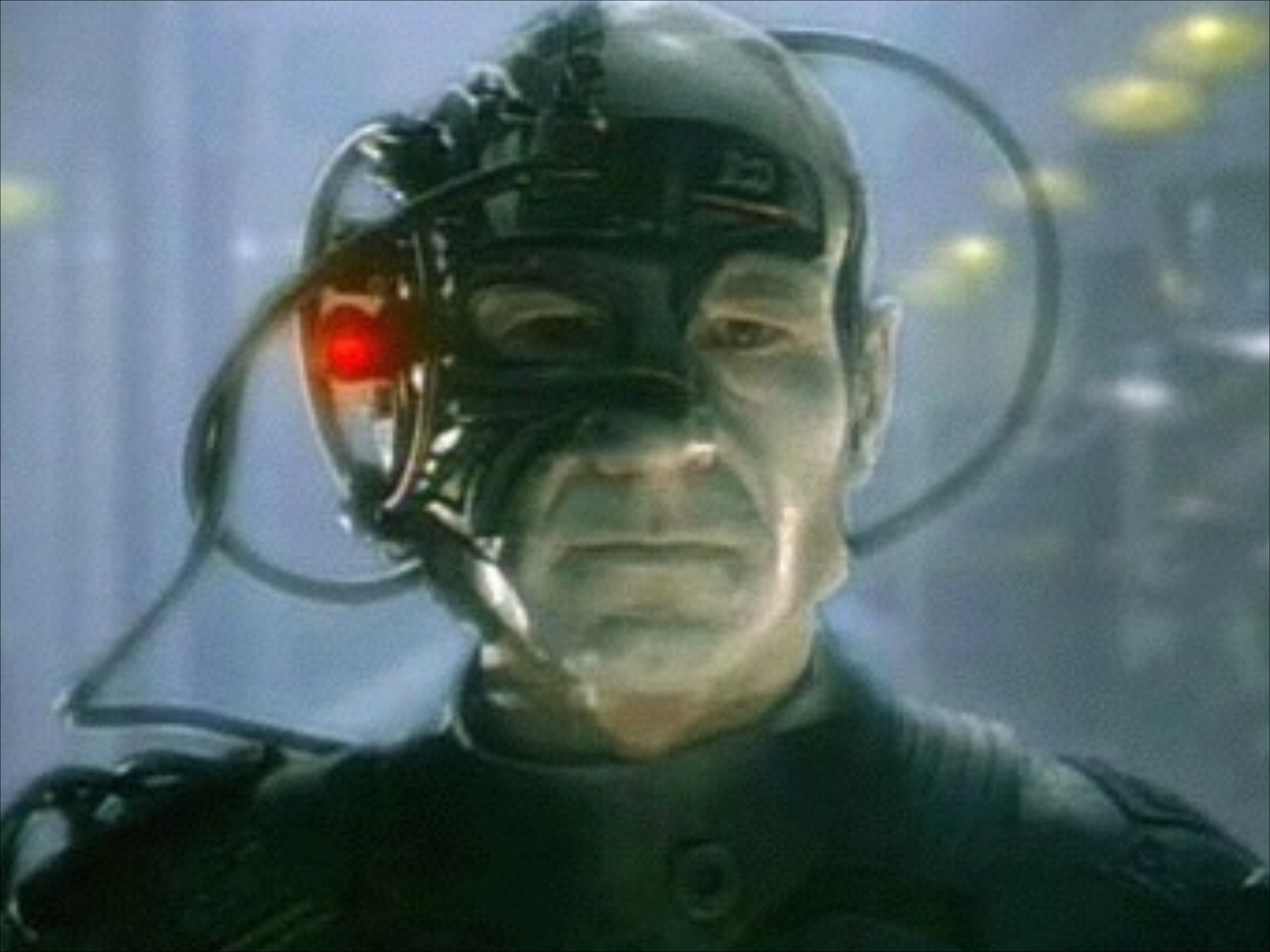
3.5: MSVC Compatibility

- More significant than just Windows support
- Unusual parsing
- Name mangling
- Built-in types
- Delayed template parsing

clang-cl.exe

- A cl.exe drop-in replacement driver
- Visual Studio integration





How?

The Clang Parser

- Hand-written recursive-descent parser.
- A single unified parser for C/C++/ObjC
- (Mostly) decoupled from the AST representation

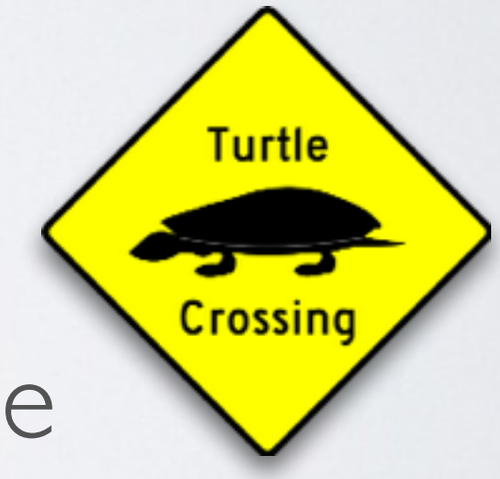
Clang Semantic Analysis

- Sema: The brains of the operation.
- Builds the AST and computes types, linkage etc.
- Some problems here too.

What next?

The road to Faster Compilation

- **In-process** execution currently under investigation
- Multi-TU compilation supporting **modules**
- **Cached resources** across invocations
- Use **MCJIT** for constexpr compile-time evaluation?



Spot the problem in this code…

```
bool ProcessingFailed =
for (unsigned
  std::string
  // FIXME: chdir is thread hostile; on the other hand, creating the same
  // behavior as chdir is complex: chdir resolves the path once, thus
  // guaranteeing that all subsequent relative path operations work
  // on the same path the original chdir resulted in. This makes a difference
  // for example on network filesystems, where symlinks might be switched
  // during runtime of the tool. Fixing this depends on having a file system
  // abstraction that allows openat() style interactions.
  if (chdir
    llvm::

std::vector
for (unsigned
  CommandLine =
assert(!CommandLine.
CommandLine[
// FIXME: We need a callback mechanism for the tool writer to output a
// customized message for each file.
DEBUG({
  llvm::
});
```

Time for Compiler Accessibility?

- **Vision and motion impaired users code too.**
- Hierarchical documents lend themselves to **universal access**:
  - The AST is a **natural representation** here to get started.
  - *Code completion* machinery can help **select inputs** and refactoring will enable **edits** out of scope.
  - **Diagnostics** can be annotated for voice output.
- We have all the technology today, yet *no a l l y story to speak of*.

Clang & the Linux Kernel

- **clang -m16**: Code generation to support the x86 boot loader appropriate for a CPU running in 16-bit mode.

- Integrated ASM parser support imminent for all **.S files**

- Users & developers joining the LLVM community to fulfil their needs.

LLVMLinux
11:00 AM

The Clang AST

- Abstract Syntax Tree represented as a C++ class hierarchy
- Uses LLVM's casting system, not RTTI
- Informal representation, some problems here:
  - Objective-C duplication. Function/Method, Interface/Record/Class…
  - Some semantic analysis still "performed" by AST
  - Type system omits linkage & other details, time to address this?

LLVM and Clang are **defending** your Software Freedom. Here's how…

the freedom to *innovate*

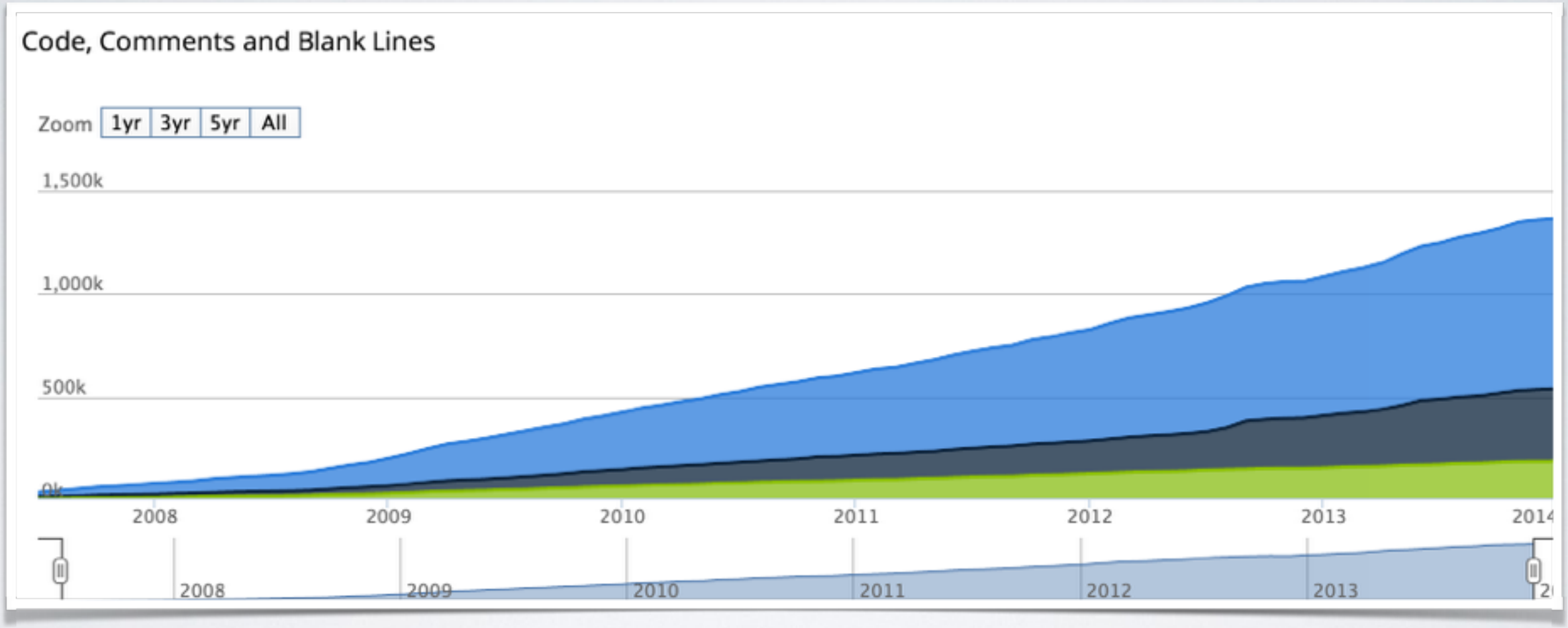
(Freedom #1)

(Freedom #2)

LLVM Community 2.0

- Do we approach *controversial issues* effectively?
- What makes a patch acceptable?
- Do we *welcome new contributors* or is there an initiation by fire?
- How should we handle *non-code contributions*?

Clang Zeitgeist 2014



30 active developers **1.5m** LoC **500** commits per month

Some introspective questions…

- Where does our **infrastructure** come from?
- Is there a framework to deal with emergencies and **existential threats** to our project?
- Do we have **transparent oversight**?
- How about…

LLVM Foundation

compilers for everyone

[proposal] [draft] [please-review]

Planet Clang

http://planet.clang.org

LLVM Weekly

http://llvmweekly.org

Optimizer pragmas & attributes

- A desire to offer *hands-on control* over the LLVM code generation and optimizer.
- Vectorization attributes
- optnone — or more granularity?

Auto-vectorization
11:00 AM

TOGETHER, WE CAN REINVENT THE COMPILER.

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