New features in Intel C/C++ Compiler 16.0 Beta

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Agenda

Compile time improvements
SSE operators
Honoring Parenthesis
Current state of C++14 and C11 support (15.0)
C++14 and C11 support (16.0 beta)
Feature macros
Comparison to GNU/Microsoft
Future plans and C/C++ standard features
Q & A
Compile Time Improvements

Intrinsic headers provided by Intel
emmintrin.h, immintrin.h, etc.

Prototypes are now automatically disabled in headers, i.e.:

extern __m128 _mm_shuffle_ps(__m128, __m128, unsigned int);
extern __m128 _mm_unpackhi_ps(__m128, __m128);

Use –D__INTEL_COMPILER_USE_INTRINSIC_PROTOTYPES to
restore old behaviour (enhanced type checking)
**SIMD Operator Support**

Using operators with the SSE integer types will now work

- These operators now supported: `+ - * / & | ^ += -= *= /= &= |= ^= == != > < >= <=`

- Example:
  ```
  __m128i x, y, z;
  x = y + z;
  ```

**Restrictions:**

- Only supports 128 and 256 bit SIMD types
- Only supports the two operand operators listed above
- The operands must have the same type (i.e. Our SSE types cannot be combinable with GNU types declared with vector_size attribute)
Honoring Parentheses

Some Intel floating point optimizations (like –fp-model fast) do not require parentheses to be honored in real and complex expressions, i.e.

\[
\text{double } a, b = 1; \\
\text{a = (1 + b) + 3;}
\]

Switch:

-\f[no-]protect-parens (Linux) –Qprotect-parens[-] (Windows)

enable/disable(DEFAULT) a reassociation optimization for REAL and COMPLEX expression evaluations by not honoring parenthesis
Current Support (15.0)

Full C++11 support

Very limited C11 support (only binary literals)

Minimal C++14 support (decltype auto, lambda init capture, deduced return types for routines)

Comparison to GNU and Microsoft can be found at:

C11 Features

_Alignment features (_Alignas, _Alignof)
_Static_assert
_Thread_local keyword
Type generic selections (_Generic)
#define  pow(X) _Generic((X), long double: powl, \
    default: pow, \
    float: powf)(X)
Noreturning functions (_Noreturn)
Unicode strings
C11 anonymous unions
_Atomic keyword*** NOT IN 16.0 (used in stdatomic.h)
C++14 Features in 16.0

Generic Lambdas

- auto glambda = [] (auto a) { return a; };

Generalized lambda captures

```cpp
int x = 4;

int z = [&r = x, y = x+1] {
  r += 2; // set x to 6; "R is for Renamed Ref"
  return y+2; // return 7 to initialize z
}(); // invoke lambda
```

Digit Separators

- auto million = 1’000’000;
C++14 Features in 16.0

The `[[deprecated]]` attribute

`[[deprecated]]` void foo() {}; // warning on call to foo()

Function return type deduction, i.e.:

```cpp
class auto foo(int i) {
    if (i == 1) return i;
    else return foo(i-1)+i;
}
```
C++14 features not yet implemented in 16.0

Relaxed constexpr restrictions, i.e.:

- Local variable declarations (except for static or __thread_local)
- if, switch, for, while, do-while statements (not goto)
- constexpr member functions are not implicitly const

Variable templates, i.e.:

- template<typename T>
- constexpr T pi = T(3.1415926535897932385);
- template<class T> T area_of_circle_with_radius(T r) { return pi<T> * r * r; }
Feature Test Macros

Testing for existence of header files:

```c
#if __has_include("shared_mutex")  // use standard header
#elif __has_include("boost/shared_mutex.h") // use BOOST header
#endif
```

Testing for existence of compiler features:

```c
#ifndef __cpp_constexpr
// no constexpr functionality available
#elif __cpp_constexpr == 200704
// c++11 constexpr functionality available
#else
// c++14 relaxed constexpr functionality available
#endif
```
GNU Compatibility

To enable c11 or c++14 support you need to use –std=c11 or –std=c++14 switch

We currently support all C++14 features used in the GNU 5.0 versions of the headers enabled when you use the switch and all c11 features except _Atomic which is used in <stdatomic.h>

Depending upon the GNU on your system (i.e. g++ in your PATH) you may get different features enabled
Microsoft Compatibility

Microsoft has been slower than GNU in implementing new C++11, C++14, and C11 features although MSVC++ 2015 has added many of them.

- Still missing are C++11 standard attributes, char16_t and char32_t, full constexpr, unicode string literals, expression SFINAE, and most of the C++14 features

No special command line switch to access C11 or C++11 or C++14 functionality

Intel® C++ compiler is compatible by default

- Whatever features are provided by the reference Microsoft compiler are available with Intel Windows* compiler

To get additional C++14 functionality with our compiler use Intel-specific /Qstd=c++11 or /Qstd=c++14 or /Qstd=c11 switches

Intel C++ Compiler is fully compatible with the Microsoft Visual C++ 2015 with respect to C++14 and C11 functionality
Future C++ Features (C++17 & beyond)

resumable/await
Terse range-based for loop
Nested namespaces
Removal of trigraphs
Addition of a default text message for static_assert
Attributes for namespaces and enumerators
UTF-8 character literals
Constant evaluation for all non-type template arguments
C++ Technical Reports in Progress

Concepts
File System Utilities
Networking Utilities
Library Fundamentals
Array Extensions
Extensions for Parallelism
Extensions for Concurrency
Transactional Memory
References

C++14 FDIS


Individual papers

http://www.open-std.org/JTC1/SC22/WG21/docs/papers/

Technical Report on Feature Macros:

https://isocpp.org/std/standing-documents/sd-6-sg10-feature-test-recommendations

C++ FAQ

http://www.stroustrup.com/bs_faq.html
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