GCC 7 Support Preview

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Contents

Contents

Discontinuing GCC 4.1 support

Previously announced statement of deprecation:

GNU C Compiler Collection (GCC) 4.1

Currently, z/TPF supports both the GCC compilers 4.1 and 4.6. Clients are required to move to GCC 4.6 as new z/TPF capabilities, such as MongoDB, can only be compiled with GCC 4.6. Support for GCC 4.1 will be discontinued on June 30, 2018. z/TPF Object Code Only (OCO) code created after June 30, 2018, will be compiled with GCC 4.6. To receive compiler or C/C++ language support, client applications must be built by using GCC 4.6 or another compiler supported by z/TPF.

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z/TPF deliverable (APAR)

- All OCO libraries rebuilt using GCC 4.6
  - GCC 4.6 will be used for all OCO updates going forward.
- MakeTPF tools updated to no longer allow GCC 4.1
- Some .mak file updates to remove any GCC 4.1 guards
- No additional rebuild requirements beyond OCO updates
- Target release early 3Q 2018
  - GCC 7 support will be a separate deliverable with a target release in late 3Q 2018.

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Customer migration to GCC 4.6

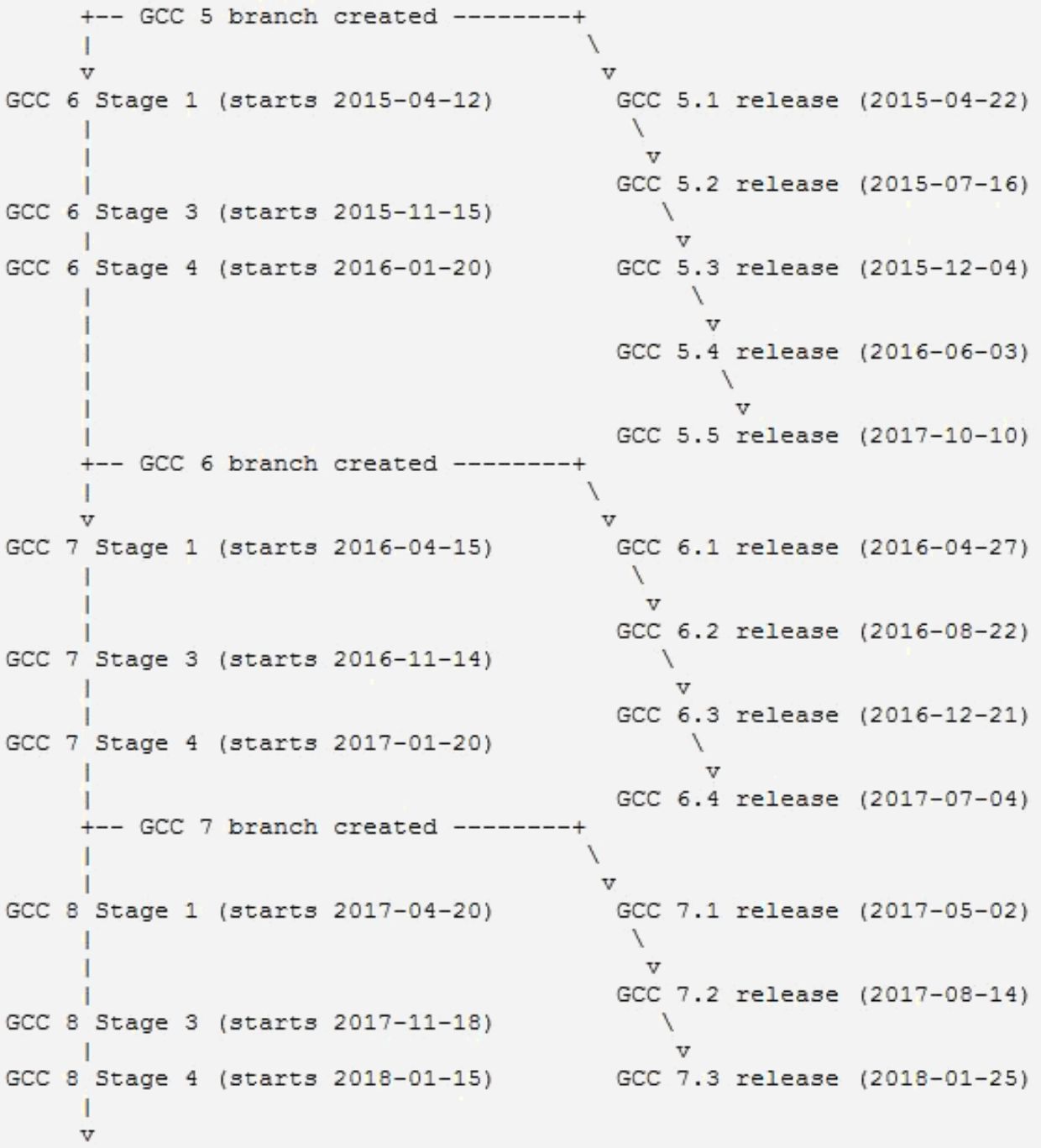
- Can be done at any time, do not need to wait for GCC 4.1 discontinuation APAR
- Obtain the GCC 4.6 cross-compiler (and support contract)
- Rebuild and reload minimum set of necessary z/TPF and opensource components using GCC 4.6
  - This includes archives (libgcc.a, libtpf_eh.a), CPP1HDRS46, and the libstdc++ library itself (CPP1).
- Rebuild and reload all z/TPF product code using GCC 4.6
- Rebuild and reload all C/C++ application code using GCC 4.6
  - Initial rebuild request is a **recommendation only**. You do not need to immediately rebuild all product or application code with GCC 4.6. However, if you encounter a compiler-related problem after June 30, you will be asked to do so for the related modules and verify the problem still exists.

Contents

GCC 7

Why upgrade to GCC 7?

- Last release of the 4.1 branch (4.1.2) was 11 years ago
- Last release of the 4.6 branch (4.6.4) was 5 years ago
- 6 newer branches, or release series, since GCC 4.6
- GCC 7 is current and should remain open for 2 more releases
  - Current = ability to support the latest standards, architecture levels, and optimizations
  - Open = ability to commit z/TPF opensource mods into mainline
- GCC 7 support in addition to continued z/TPF support of GCC 4.6
  - The GCC 4.6 branch being closed for support is not the same as z/TPF no longer supporting the compiler.



GCC Feature Additions

GCC 4.6
(2011/03/25 – 2013/04/12)

C11 experimental support
C++11 experimental support

Max z10 instruction set support

GCC 5
(2015/04/22 – 2017/10/10)

C11 full support (default)
C++11 full support
C++14 full experimental support

Max z13 instruction set support

General optimizer improvements

std::string now uses small string optimization instead of copy-on-write reference counting

std::list::size() now O(1)

GCC 6
(2016/04/27 – est. 2018)

C11 full support (default)
C++11 full support
C++14 full support (default)
C++17 experimental support

Max z13 instruction set support

General optimizer improvements (in addition to GCC 5)

New -Wmisleading-indentation warning, among others

GCC 7
(2017/05/02 – est. 2019)

C11 full support (default)
C++11 full support
C++14 full support (default)
C++17 full experimental support

z14 instruction set support

General optimizer improvements (in addition to GCC 6)

New builtin vector instructions via -mzvector option

Contents

New C++ standards

New supported C++ standards:

- Full C++11
  - GCC 4.6 only has experimental, “nearly all” C++11 support: https://gcc.gnu.org/gcc-4.6/cxx0x_status.html

C++ standards available for future z/TPF support (may require infrastructure updates):

- Full C++14
  - Minor standard update
  - <shared_mutex>, type deduction, [[deprecated]] attribute
- Full experimental C++17 (eventual full, non-experimental)
  - Major standard update
  - Parallel algorithm execution, shared_mutex class, shared_ptr with an array, <filesystem>, Boost extensions (any, optional)

C++14/17 <shared_mutex> example

C++14 adds the <shared_mutex> header

– Specifically std::shared_lock and std::shared_timed_mutex

C++17 adds std::shared_mutex

– Member functions:

  • Exclusive locking: lock, try_lock, unlock (same as std::mutex)

  • Shared locking: lock_shared, try_lock_shared, unlock_shared

– Would still obtain an exclusive lock for writing, but can now obtain multiple shared locks for reading simultaneously

```
#include <shared_mutex>

std::shared_mutex lock;
unsigned int avail_seats;  //thread safe counter

unsigned int read(){
    lock.lock_shared();
    unsigned int rc = avail_seats;
    lock.unlock_shared();
    return rc;
}

bool reserve(){
    lock.lock();
    bool rc = false;
    if (avail_seats > 0){
        --avail_seats;
        rc = true;
    }
    lock.unlock();
    return rc;
}
```


Contents

New Z instruction sets

Compiler options:

- -march=*cpu-type*: generate code that runs on *cpu-type*
- -mtune=*cpu-type*: tune to *cpu-type* everything applicable about the generated code, except for the ABI and instruction set

Supported -march= and -mtune values:

- Same as GCC 4.6: z900, z990, z9-109, z9-ec, z10
- Included in GCC 7: z196, zEC12, z13, and z14

z/TPF currently uses -march=z10 -mtune=z9-109

- -mtune=z9-109 is due to an optimization issue with our current pairing of GCC and Glibc versions
- GCC 7 support plan to ship with -march=z10 -mtune=z13
  - Will test -march=z13 and -march=z14 and relay any concerns

New GCC 7 optimizations

Previous z10 optimization error involving memory copy and comparison functions

- memcpy, memcmp, strcpy, strcmp
- Required -mtune=z9-109 for GCC 4.6 to revert back to builtin compiler functions instead of Glibc versions of the functions
- Issue will be addressed via a Glibc update, which will allow for tuning to more recent architecture levels

GCC 7 performance testing will be done

- No specific expectations, but will share the results

Thank you

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Trademarks

Notes

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

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