Require span & basic_string_view to be Trivially Copyable

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Introduction

Given its definition, it is strongly implied that span & basic_string_view are trivially copyable, but that is not yet a requirement.

Revision History

R1

- Expanded on the motivation.
- Added poll results from LEWG telecon discussion on 2021-Mar-16.
- Corrected description about Compiler Explorer link (it refers to three, not two, standard library implementations).
- Note: No change to the technical specification.

Motivation and Scope

It is desirable that span and basic_string_view be trivially copyable for the following reasons:

- In heterogeneous computing, trivially copyable is heavily used as a proxy for types which can be copied between a host (such as a CPU) and a device (such as a GPU) or between two devices by just copying the bytes which make up the object representation of the type. If they are not trivially copyable, heterogeneous computing would not be able to use these types as vocabulary types.
- These types are already trivially copyable in all the major standard library implementations and developers may already be dependent upon it. That very question was asked about string view on Stack Overflow over two years ago.

Both span and basic string view have:

- Defaulted copy constructors
- Defaulted copy assignment operators
- Defaulted destructors
- Exposition-only types consisting of a raw pointer and a size t.
- Many member functions that are constexpr, and in C++17 would have required trivial destruction (for basic string view as span was added in C++20).

Because of the above, it is strongly implied that these are trivially copyable types. However, that is not a stated requirement.

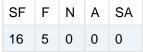
Furthermore, libstdc++, libc++ and MSVC implement them as trivially copyable types: <u>https://godbolt.org/z/nWY3dv</u>.

I ran this by LWG and there was support for it with no objections.

Poll

We took the following poll at the LEWG Telecon discussion on 2021-Mar-16:

POLL: Send <u>P22510R0</u> (Require span & basic_string_view to be Trivially copyable) to LEWG Electronic Balloting for C++23, with priority B2: Improvement.



of Authors: 1

of Participants: 30

Author Position: SF

Outcome: Unanimous consent

Impact on the Standard

This is purely additive to the standard.

Technical Specifications

These changes are relative to C++20:

In [span.overview], add:

span<ElementType, Extent> is a trivially copyable type.

ElementType is required to be a complete object type that is not an abstract class type.

In [string.view.template.general], add:

The complexity of $basic_string_view$ member functions is O(1) unless otherwise specified.

basic string view<chart,traits> is a trivially copyable type.

Acknowledgements

Thanks to Barry Revzin for pointing out that basic_string_view is strongly implied but not strictly required to be trivially copyable. Thanks to Jonathan Coe, Casey Carter for supporting this direction and encouraging me to write this paper, and an additional thanks to Jonathan Wakely for that as well as reviewing the wording.

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References

C++20: Programming Languages – C++, International Standard ISO/IEC 14882, Sixth edition 2020-10

Stack Overflow: <u>Is std::string_view trivially copyable?</u>