WG21 2019-07 Cologne
Record of Discussion

ISO/IEC JTC1 SC22 WG21 P1840 — 2019-07-27

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Chair: John Spicer

1. Opening activities

John Spicer opened the meeting at 9:03 UTC+2.

1.1 Opening comments, welcome from host

Nico Josuttis welcomes the group and thanks the sponsors.
Nico Josuttis presents the local amenities.

John Spicer presents the meeting agenda. The agenda is available on the wiki. If you are new, please ask the person next to you for information on how to access the meeting wiki.

1.2 Meeting Guidelines

Every participant is responsible for understanding and abiding by the following:

- The INCITS Antitrust Guidelines (PL22.16)
- The INCITS Patent Policy (PL22.16)
- The ISO Code of Conduct
- The IEC Code of Conduct
- The WG21 Practices and Procedures, and Code of Conduct

John Spicer presents the meeting guidelines. Please take the time to review these documents.
The links are on the wiki.
If you have any CoC issues, please approach a committee officer or a NB representative and bring it to their attention.

If you have any technical issues or concerns, please bring them up as soon as possible.

1.3 Membership, voting rights, and procedures for the meeting

John Spicer presents. Meetings are not public, but we do welcome visitors. Please refrain from live tweeting, blogging, taking photos or videos.

John Spicer presents voting rights.

Hal Finkel presents. Please sign in on the attendance sheet which is outside of this room. Hal presents the structure of the attendance sheet. If your name is not on the list, or if there is anything wrong with the information on the membership list, please feel free to correct it on the sheet. Do wear your name tags to help scribes identify you. If you are not on the list, you will not have a name badge. Please fill in an empty one. Apologies for any errors.

If you need a paper number, please use the isocpp.org website. If you do not have access to the paper number system, please send me or Herb Sutter an e-mail.

1.4 Introductions

Officers, WG chairs and SG chairs introduce themselves.
First time attendees introduce themselves.
John Spicer welcomes first time attendees.

1.5 Agenda review and approval

John Spicer presents the agenda for the meeting. The meeting will finish no later than 2pm on Saturday, but WGs may continue working.

John Spicer presents the meeting goals. Primary goal is to work on C++20 features and to start the CD ballot.

Herb Sutter presents. Welcome to all the new people. There are 13 national bodies at this meeting. On the wiki there is a new page that contains meeting persistent information including a getting started page.
Herb Sutter presents the committee organisation, 3 stage pipeline and the active study groups.

The bottleneck is in the second and third stages. This is by design.
We are the stage where we do not take in new features, but there may be exceptions. We are sending out a CD ballot at the end of this meeting. There will be a vote on Saturday to approve it.
We will have two meetings to resolve bug fixes and NB comments. Some things may be fixed after shipping. During this and the next two meetings we want to tie up the loose ends and start with C++23.

Will my paper make C++20 ? If LEWG or EWG agrees it is a bug fix or that it is an exception, and if the group accepts it, then it goes to the end of the queue for CWG and LWG. Library is already full.

A paper that missed C++20 will go to the next ship vehicle.

What if you need to follow two papers, but they're in the different groups that have scheduled them at the same time? If you are the author of both of those papers, talk to the chairs. Otherwise, we can't accommodate all scheduling requests.

PL22/16 motion to approve the meeting agenda.
Marshall Clow moves. Adam Martin seconds. The motion is unanimously approved by PL22/16.

WG21 motion to approve the meeting agenda.
The motion is unanimously approved by WG21.

1.6 Editor's reports, approval of working drafts

Document	Editor's report	Prospective WD
C++20 Standard	N4821	N4820
Library Fundamentals TS	N4807	N4806
Reflection TS	N4819	N4818

John Spicer presents. There was an update to the Reflection TS to prepare it for the rebasing.

PL22/16 motion to approve editor's reports and working drafts.
Marshall Clow moves. Barry Hedquist seconds. The motion is unanimously approved by PL22/16.

WG21 motion to approve editor’s reports and working drafts.
The motion is unanimously approved by WG21.

1.7 Approval of the minutes of the previous meetings

Meeting	Minutes
WG21 Kona	N4805
PL22.16 Kona	pl22.16-2019-00003
WG21 pre-Cologne administrative telecon	N4822

PL22/16 motion to approve minutes of the previous meeting.
Marshall Clow moves. Barry Hedquist seconds. The motion is unanimously approved by PL22/16.

WG21 motion to approve minutes of the previous meeting.
The motion is unanimously approved by WG21.

2. Liaison reports, and WG21 study group reports (see pre-meeting WG21 telecon minutes)

No discussion.

3. WG progress reports and work plans for the week (Core, Evolution, Library, Library Evolution; see pre-meeting WG21 telecon minutes)

No discussion.

4. New business requiring action by the committee

No discussion.

5. Organize working groups and study groups, establish working procedures

John Spicer presents. WG and SG chairs must have proposals on the straw poll page no later than 8pm on Friday, but they are generally posted as they are ready during. Please see straw poll page for updates so you can prepare for the vote on Saturday. If you have any questions or concerns, please bring them up with papers authors and/or SG/WG chairs to avoid surprises on Saturday that could have been dealt with earlier.

6. WG and SG sessions

Jens Maurer polls for Belfast and Prague meeting attendance. If you want to volunteer to bring projectors to the next meeting talk to your SG chair.

Jens Maurer presents meeting room assignments. Meeting room assignments is on the table outside and on the wiki.

Jens Maurer presents the evening sessions. Evening sessions start at 7:30 and must end by 10pm. The schedule is on the wiki.

Jens Maurer presents the meeting schedule. Do not leave the projectors in the meeting rooms over night.

Please make sure your new feature has a feature test macro. If you have questions, please ask John Spicer.

If you need help for a core wording, come talk to me.

John Spicer presents. We use a shared wiki login. Do not edit the wiki, unless you have been asked to do so. Attaching papers is fine.

Direction Group report, Michael Wong presents. DG re-confirms support for the C++ schedule as published in P1000R1. At this meeting we need to complete the CD ballot and start working on C++23 features. In Belfast we should focus on CD ballot comment resolution.
We need to refrain from being inventive at this meeting. This is the time to be conservative about what to add and aim to increase consensus. We need to be fixing bugs in the mature features and ship the CD.

We endorse Ville’s Plan for C++23 which is largely consistent with the DG position paper.

- Ville’s C++23 plan: D0592R2
- DG position paper: P0939R3

This meeting (Cologne) should not result in the addition of contract features to the status quo design. We strongly discourage any scope creep, additions, inventions now. Removing elements from the current design is okay if it increases consensus. We have a process for addressing defects. We need the experience. “The best is the enemy of the good”.

Meeting adjourned at 9:34AM UTC+2.

7. Review of the meeting (Saturday 8:30 AM)

John Spicer opened the meeting at 8:30 am UTC+2.

Herb Sutter presents.
We have a new study group - SG21 Contracts. John Spicer will be the chair.

We tried allowing Markdown and .txt files, but that experiment failed. From the pre-Belfast mailing onward we will accept html and pdf format only. If it is a revision of a previous paper, we will allow the same format as the previous revision in the post-meeting mailing.

As pointed out in P1000, we will not accept new papers unless the discussion was polled to make an exception. P1000 is a unanimously accepted paper.
There was a paper that was not discussed as a procedural exception, so I will poll before the vote to see if we want to poll to adapt this paper. I would like to see 4:1 in favour of making the exception. If this poll succeeds, we will take the poll to accept the paper.

Mike Miller: there is a fuzzy line between a bug fix and a new feature. The bug fix doesn't need an exception. Who makes a determination if it is a bug fix or a new feature ?
Herb Sutter : we want the whole group to make that decision. We have the polls in the subgroups so the chair doesn't have to make that executive decision. If at least one person thinks it is a design change, we will take a poll to decide as a group. I will put that in P1000.
Christian Trott : which papers does this apply to ?
Herb Sutter : any feature changes for C++20 at this meeting.

Thank you to the hosts for dealing with a large number of unexpected attendees.

WG and SG status and progress reports.

- ### SG2: Modules (Stone)

No report.

- ### SG5: Transactional memory (Boehm)

No report.

- ### SG6: Numerics (Crowl)

Lawrence Crowl presents. SG6 had16 papers. We processed most, but didn't get through all. We got part way through discussing the partial draft of Numbers TS.

- ### SG7: Compile-time programming (Carruth)

Chandler Carruth presents. SG7 met for met for a productive morning. We focused on resolving how to design reflection API with constexpr metaprogramming.
We saw a compromise that requires added facilities from the language. We forwarded the paper to EWG.
SG7 also looked at the update to injection. We saw how to form meta classes using injections.
We reconsidered a previous decision on which part of the code you can reflect on. We confirmed the previous decision to reflect on private members of data structures and parameter names, but with very specific constraints intended to allow implementation freedom.

- ### SG13: HMI & I/O (Human/Machine Interface) (Orr)

Roger Orr presents. SG13 met for two afternoons and had a joint session with SG16. We had an update on the web_view paper and 2D graphics paper. We gave feedback. We also had further update on the standard audio API and a paper from Apple engineers giving comments and discussing how to make further progress. We also looked at 2 papers on cancelation and callbacks.

- ### SG12: Undefined and unspecified behavior (Dos Reis)

Gabriel Dos Reis presents. SG12 met for three days and had a joint session with WG23 for an afternoon. We worked with SG14 regarding various object model examples and gave feedback. On Friday, we talked about pointer validity in the language. This gets in the way of various concurrent algorithms. We looked at web_view and gave feedback. We also looked at a paper that lists all the unexpected behaviour in the core language. The hope is to include this as annex to the standard.

- ### SG14: Games & low latency (Wong)

Michael Wong presents. SG14 reviewed several papers on linear algebra. We think there are some very good designs and have passed them both on to LEWG. There is an interest in reconciling the two papers.
We will continue to have monthly meeting on low latency aspects. We didn't get to low latency this week.
We have separate telecon that covers linear algebra. Date and times are on the wiki.

- ### SG19: Machine Learning (Wong)

Michael Wong presents. SG19 reviewed 3-4 papers on adding statistical mathematical functions to C++. This is basic functionality for a lot of machine learning. We also started talking about graph data structures. There was a general design discussion how to do this properly in C++.
Machine learning meets regularly. The dates are on the wiki.

- ### SG15: Tooling (Adelstein Lelbach)

Bryce Adelstein Lelbach presents. SG15 met on Friday, and also had 8-9 teleconferences since Kona. We looked at 7 papers. On Thursday, we discussed P1688 in EWG which is an outline and basic plan for C++ modules ecosystem TR. EWG had consensus to begin work on that. Papers that we looked on Friday were all papers for that TR, the notable one was about packaging modules. We also looked at papers on whether we want to include conventions for module naming, project structure, etc. The result of the discussions is on the wiki.
We will have telecons going forward. We are considering having one day SG15 meeting at cppcon, I will send out a poll to the mailing list to gauge interest and availability.
Thank you to all the minute takers and the presenters.

- ### SG16: Unicode (Honermann)

Tom Honermann presents. SG16 met for one day. We looked at 7 of the 8 scheduled papers; 2 were designated as SG16 and the other came from other groups. There was a lot of discussion on when we need overloads for various encoding we are supporting. We will come up with guidelines based on the polling we did.
We spoke about file names and how we want to deal with the complexity of that topic.

Thank you to the scribes.
We had an evening session which was well attended. If you want, please join our telecons. We meet approximately every two weeks. You can find all the information on our GitHub page.

- ### SG20: Education (van Winkel)

Christopher Di Bella presents. SG20 met on Thursday for full day. We discussed removing `char8_t` and `std::u8string` from education guidelines with intention of restoring it at a later date. We looked at removing contracts from the education guidelines, but we didn't reach consensus because we couldn't decide whether to re-word "contracts" to "design-by-contract" or to entirely remove the guideline until the language feature ships. We will review that in Belfast.
We looked at adding a section on delaying teaching macros until there is a genuine use case.
We looked at a paper on safety critical software and relevant integration guidelines, as well as general idioms for building types. The author introduced a new idiom we would like to see again in Belfast.
We looked at a new modular topic design where there may be overlap between modules and one can build dependency graphs.
We will meet once a month via telecons.

- ### SG1: Concurrency (Giroux)

Olivier Giroux presents. Apologies for the scheduling confusion. The schedules that go on GitHub will be the authoritative one for SG1.

We have several relevant motions:
LWG #9
- P1135, P1643, P1644, a collection of synchronization facilities
LWG #28
- P0660, the joining thread and stop token
CWG #4
- P0735, simpler release sequences (pre-req for any consume fixes)
CWG #19
- P1152, deprecating volatile

Things we are aiming for Concurrency TS 2:

Design ready now, will hold this TS train
- latest
- hazard_ptr
- RCU
- fiber_context

Included if ready, or train leaves without:
- Asymmetric fences

- atomic_{load,store}_per_byte_memcpy
- Concurrent Queues
- Concurrent Counters

Executors, the most salient polls of the week:
We want the changes of ”Suggestions for Consensus on Executors” applied to the executors proposal for the next revision had strong support.

SF	F	N	A	SA
12	13	4	0	0

We also had contentious discussion about two approaches for error handling.

It would be tolerable to ship with error handling as in P1660

SF F N A SA
9 12 4 3 4 - Consensus

It would be tolerable to ship with error handling as in P1791

SF F N A SA
4 6 9 7 6 - Not consensus

No doubt the debate isn’t over. The purpose of any further debate would be to increase consensus.

We had a lot of memory model experts in the room. We talked about out of thin-air and we maybe have a solution.
Thanks to the scribes!

- ## SG17: EWG Incubator (Bastien)

JF Bastien presents. SG17 met for two days and saw 18 papers. We have a backlog about 10 papers waiting to be refreshed. Out of 18 we saw, we asked 10 to come back with more details. Further 2 papers had no consensus to go forward, and 6 papers were sent to other groups. All the details are on the wiki.

- ## Evolution (Voutilainen)

Ville Voutilainen presents.

Contracts
Evolution discussed multiple different approaches for Contracts for C++20; after initially choosing to pursue P1607R0 Minimizing Contracts, decided to go with D1823R0 Remove Contracts from C++20. Expecting Contracts to make a comeback for C++23.

Coroutines

Evolution discussed P1745R0 Coroutine changes for C++20 and beyond, and P1485R1 Better keywords for the Coroutines; there was no consensus to adopt either of these.

Modules
Evolution approved what can be considered as bugfixes and a minimal amount of library support for Modules; these are

- D1811R0 Relaxing redefinition restrictions for re-exportation robustness,
- P1502R0 Standard library header units for C++20,
- P1703R0 Recognizing Header Unit Imports Requires Full Preprocessing,
- and P1766R0 Mitigating minor modules maladies.

All Your Spaceships Are Belong to Us
Evolution approved P1630R0 Spaceship needs a tune-up: Addressing some discovered issues with P0515 and P1185. This makes the reversed operator candidates be required to return bool, and deletes defaulted operators for types with reference members or variant members.

Concepts
Evolution approved P1452R1 On the non-uniform semantics of return-type-requirements; this removes an expression constraint -> Type, and C++ now necessitates the use of -> std::same or -> std::convertible_to. Evolution also approved P1616R0 Using unconstrained template template parameters with constrained templates.

A couple of small fixes
Evolution approved

- P1668R0 Enabling constexpr Intrinsics By Permitting Unevaluated inline-assembly in constexpr Functions,
- P1675R0 rethrow_exception must be allowed to copy,
- and P1771R0 nodiscard for constructors.

Floating-point types as non-type template parameters
Evolution approved P1714R0 NTTP are incomplete without float, double, and long double!. This allows floating point types as NTTPs, by making their comparison be done in terms of bit representation. While this is somewhat novel and late, it's allegedly possible to write a work-around in C++20 with a fairly small amount of code, and Evolution elected to support floating-point types directly.

Nico Josuttis: do we have a paper with the work-around ?
Ville : it is in the paper. It runs in gcc in godbolt but not in any other compiler. I don't have certainty if that example is well formed.
Gabriel Dos Reis : will this be moved today ?
Herb Sutter : this is the motion where we will first take a poll to see if we want to take the poll.

Near-future EWG plans

The high-order bit of our next steps is ballot resolution in Belfast. Once that is done, Evolution will switch into full C++23 mode.

- ## SG18 LEWG Incubator (Adelstein Lelbach)

Bryce Adelstein Lelbach presents.

Direction Review: 19 (30 in Kona)
Design Review: 10 (6 in Kona)
Design Feedback: 6 (7 in Kona)

No consensus to spend more time: 4
Sent to LEWG: 13
No Action: 2
Further design review in LEWGI needed: 7
Further direction review in LEWGI needed: 4
Further design feedback in LEWGI needed: 5

LEWGI Work this Week
P1750 Process Management Library Numerics TS Papers
P1031 Low Level I/O Library
P1108 Web View
P1673 Linear Algebra

Thank you to everyone who participated.

Botond Ballo: can you say a few words on your categories ?
Bryce : direction review are papers which we need to decide if we want to pursue solving that problem in the standard library. Design review is for when we want to solve that problem, but we need to refine the solution before we send it to LEWG. Design feedback is for papers that other groups are also looking at. This means we are giving early design feedback as the paper is going through other study groups.

- ## Library Evolution (Winters)

Titus Winters presents. 58 papers reviewed (53 last time), 20 papers left unreviewed (~15last time). Around 25 fixes for C++20

Policy Changes approved:
Form a LEWG Design Omnibus Standing Document.
Delayed:
Updates to SD-8 (calling x.operator +(y))
Changes to the Lakos Rule

Forwarded to LWG for IS :
P1754 - Rename concepts to standard_case for C++20, while we still can

Text formatting (std::format)

P1650 - Output std::chrono::days with 'd' suffix
P1652 - Printf corner cases in std::format
P1636 - Formatters for library types

Ranges and Algorithms

P1522 - Iterator Difference Type and Integer Overflow
P1739 - Type erasure for forwarding ranges in combination with "subrange-y" view adaptors
P1716 - ranges compare algorithm are over-constrained
P1638 - basic_istream_view's iterator should not be copyable
P1523 - Views and Size Types
P1207 - Movability of Single-pass Iterators
P1474 - Helpful pointers for ContiguousIterator

Misc

P1643 - Add wait/notify to atomic_ref
P1644 - Add wait/notify to atomic
P1690 - Refinement Proposal for P0919 Heterogeneous lookup for unordered containers
P1661 - Remove dedicated precalculated hash lookup interface
P1651 - bind_front should not unwrap reference_wrapper
P1612 - Relocate Endian's Specification
P1639 - Unifying source_location and contract_violation
P1423 - char8_t backward compatibility remediation
P0980 - Making std::string constexpr
P0593 - (Just the naming of bless)
P1152 - Deprecating volatile
P1048 - A proposal for a type trait to detect scoped enumerations
P1682 - std::to_underlying
P1317 - Remove return type deduction in std::apply
P1251 - A more constexpr bitset
P0943 - Support C atomics in C++

Forwarded to LWG for C++Next
P1072 - basic_string::resize_default_init
P1659 - starts_with and ends_with
P1348 - An Executor Property for Occupancy of Execution Agents
P1147 - Printing `volatile` Pointers
P1760 - snapshot_source - A Horse with a Better Name
P1679 - String substring checking

Discussed, but not forwarded :
Executors (several papers)
P1737 - unique_function vs. any_invokable - Bikeshedding Off the Rails
P1764 - ssize() Should be Named count()
P1610 - Rename await_resume() to await_result()
P1727 - Issues with current flat_map proposal
P1702 - Annex D Means Deprecated

P1681 - Revisiting allocator model for coroutine lazy/task/generator
P0401 - Providing size feedback in the Allocator interface
P1655 - LEWG Omnibus Design Policy Paper
P1684 - mdarray: An Owning Multidimensional Array Analog of mdspan
P1408 - Abandon observer_ptr
P0709 - Zero-overhead deterministic exceptions: Throwing values
P1028 - SG14 status_code and standard error object for P0709 Zero-overhead deterministic exceptions
P1030 - std::filesystem::path_view
P1318 - Tuple application traits
P1278 - offsetof For the Modern Era
P0350 - Integrating simd with parallel algorithms
P1280 - Integer Width Literals

Ville Voutilainen : do you have plans to publish library material that didn't make it into C++20 in a TS instead ?
Titus Winters : that would be useful for the new types, but we don't have any of those yet. There is works towards a TS3, none of it necessarily happened here.
Peter Sommerlad : is there a timebox for TS3 ?
Titus Winters : I'm not aware of a concrete pan, but I suspect we will start that process soon.
Marshall Clow : there will be a lot of discussion before Belfast.

◦ Core (Miller)

Mike Miller presents.

CWG reviewed proposals for C++20. 24 are being moved today, 8 reviewed and passed on to LWG, 4 deferred until post-CD, 2 moot (contracts-related).
Issues processing has been deferred until after plenary. We expect to have 3 teleconferences before Belfast to deal with issues processing.

Special Notes on Motions:
- There is only one issue-resolution motion. There was no issues processing during last meeting, Issues resolved during 4 between-meeting teleconferences.
- Motion 2 (P1161R3) was ready in Kona, but omitted due to clerical error (apologies)
- Three (non-issues) motions designated as “Defect Reports” (i.e., retroactively applicable):
    ○ P1766R1 (Mitigating minor modules maladies)
    ○ P1771R1 ([[nodiscard]] for constructors)
    ○ P1825R0 (Merged wording for P0527R1 and P1155R3 [more implicit move contexts])

There are several papers that are not aimed at the CD.
Papers that were deemed by authors not to be critical for the CD:
    ○ P1697 (Require a diagnostic for “declaration changes meaning")

- ○ P1624 (Resolving technical issues in parameter mapping equivalence and related problems)

Papers not for CD because we ran out of time:

- ○ P0593 (Implicit creation of objects for low-level object manipulation)
- ○ P1306 (Expansion statements)

Contracts-related changes

- ○ P1607 (Minimizing Contracts)
- ○ P1344 (Pre/Post vs. Enspects/Exsures)

Timur Doumler: what do you expect to happen to papers in the ran out of time category ?
Mike Miller : we haven't decided yet. We may be able to deal with them as NB comments, but I would expect they will not go into C++20 as they are fairly large.
Hubert Tong : the inheriting constructors of the CTAD paper is in the same situation.
Mike Miller : we spent a lot of time dealing with tweak to CTAD and there are a couple of papers we are moving today to add facilities to CTAD for aliases and for aggregates. The third part was dealing with inheriting constructors, but we didn't have time to complete it in time for C++20.
Walter Brown : what is the status of the Davis's papers ?
Mike Miller: we potentially considered for C++20 a paper that dealt with dusty ares of name lookup. Davis produced a paper which was not intended to be a design change, just a foundation for what lookup should be. We decided it was not necessary for C++20. We polled NBs, and NBs were fine with this change and a few expressed a preference to apply it after the CD. We deferred it never the less due to lack of time.
Marshall Clow: in LWG we have a few issues like this with mechanical changes to the library wording. These papers will all be considered after the CD has been produced, but will be in the pre-Belfast mailing.

Adam Martin : the two issues that were not handled because you ran out of time, will they get into the language for C++20 ?
Herb Sutter : I was asked by NB if we can get stuff in as NB comments. We don't add features after we ship the CD. If it is a bug fix, that's fine. If it is questionable whether it is a bug fix or not, we will have a poll to decide whether we want to look at it.
Fabio Fracassi : there are library stuff which, if we don't get them now, we won't get them ever.
Herb Sutter : if you feel strongly file an NB comment. I hope that falls under a fix anyway.
Hubert Tong: there is a contacts related issue resolution.
Mike Miller : one motion included a fix to a contract related wording. It was removed from the motions page last night.

Hubert Tong : is the first Contracts paper going to be a motion if the Contracts removal fails ?
Mike Miller : we made requests for changes to that paper and they have not be processed before the removal.

Davis Herring : EWG polled to withdraw the first Contracts paper. We should not poll on it.

CWG Motions

Motion 1
Move to accept as Defect Reports all issues in P1510R0 (Core Language Working Group "tentatively ready" Issues for the July, 2019 (Cologne) meeting) and apply the proposed resolutions to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 2
Move to apply the changes in P1161R3 (Deprecate uses of the comma operator in subscripting expressions) to the C++ working paper.

Mike Miller : the original motions referred to revision 2 of this paper. Thank you for Hubert Tong for pointing it out. The motion has been updated to reflect the latest revision of this paper. Apologies for the confusion.

Objection to unanimous consent.
Herb Sutter reminds the group of the voting rules.

In favor: 61
Opposed 1
Abstain : 8
Motion passes.

Motion 3
Move to apply the changes in P1331R2 (Permitting trivial default initialization in constexpr contexts) to the C++ working paper.

No discussion.
Objection to unanimous consent.
In favor : 61
Opposed : 0
Abstain : 11

Motion passes.

Motion 4
Move to apply the changes in P0735R1 (Interaction of `memory_order_consume` with release sequences) to the C++ working paper.

No discussion.
No objection to unanimous consent.

Motion passes.

Motion 5
Move to apply the changes in P0848R3 (Conditionally Trivial Special Member Functions) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 6
Move to apply the changes in P1186R3 (When do you actually use `<=>`?) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 7
Move to apply the changes in P1301R4 (`[[nodiscard("should have a reason")]]`) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 8
Move to apply the changes in P1099R5 (Using Enum) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 9
Move to apply the changes in P1630R1 (Spaceship needs a tune-up) to the C++ working paper.

Alisdair Meredith : please make sure the paper name describes the change.
John Spicer : people are discouraged to avoid cute names unless they are descriptive as well.

No objection to unanimous consent.
Motion passes.

Motion 10
Move to apply the changes in P1616R1 (Using unconstrained template template parameters with constrained templates) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 11
Move to apply the changes in P1816R0 (Wording for class template argument deduction for aggregates) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 12
Move to apply the changes in P1668R1 (Enabling `constexpr` Intrinsics By Permitting Unevaluated inline-assembly in `constexpr` Functions) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 13
Move to apply the changes in P1766R1 (Mitigating minor modules maladies) to the C++ working paper and accept the changes therein for default arguments and classes having typedef names for linkage purposes as Defect Reports.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 14
Move to apply the changes in P1811R0 (Relaxing redefinition restrictions for re-exportation robustness) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 15
Move to apply the changes in P0388R4 (Permit conversions to arrays of unknown bound) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 16

Move to apply the changes in P1823R0 (Remove Contracts from C++20) to the C++ working paper.
There are objections in the room.
In favour : 68
Opposed : 0
Abstain : 4
Motion passes.

Herb Sutter : Contracts is continuing work. Thank you to John for volunteering to chair it. We saw great progress this week in the evening session. Thank you to everyone who have put in work to this feature and who will continue to do so.
John : I'm committed to seeing this completed and completed expeditiously.

Motion 17
Move to apply the changes in P1143R2 (Adding the `constinit` keyword) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 18
Move to apply the changes in P1452R2 (On the non-uniform semantics of *return-type-requirement*s) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 19
Move to apply the changes in P1152R4 (Deprecating `volatile`) to the C++ working paper.

Mike Miller : this paper had both library and core components. Because of the great work load of LWG thy were not review their part. The motion only has CWG part of the paper.

There are objections in the room.
In favour : 63
Opposed : 1
Abstain : 7
Motion passes.

Motion 20
Move to accept the changes in P1771R1 (`[[nodiscard]]` for constructors) as a Defect Report and apply them to the C++ working paper.

No discussion.

No objection to unanimous consent.
Motion passes.

Motion 21
Move to apply the changes in P1814R0 (Wording for Class Template Argument Deduction for Alias Templates) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 22
Move to apply the changes in P1714R1 (NTTP are incomplete without float, double, and long double!) to the C++ working paper.

Herb Sutter : we will poll to consider this motion. This is possibly a new feature and we had a new feature cut off. Vote in favour if you think we should grant an exception to P1000 or if you think it is a bug fix.

Botond Ballo : should we have the procedural motion be a motion?
Herb Sutter : yes, that would be helpful and we will have it in the future.
Eric Niebler : this motion doesn't have an effect on ISO level because we haven't put out a CD.
Herb Sutter : correct, this is about our schedule which we agreed to unanimously.
Barry Hedquist : what is NTTP ?
Herb Sutter : non-type template parameter
Tom Honermann : do implementers think this is a bug fix ?
Herb Sutter : if you are a compiler implementer please vote on the next information straw poll.
Is this a bug fix ?
yes : 0
no : 14
abstain: 0

Michał Dominiak : Ville said there are templates experts that consider the proposed workaround not to be well formed.
Ville Voutilainen : we didn't really talk about that example much. It seemed like some people presume it's well formed, but that has been questioned.
Botond Ballo : because this was not discussed it seems like new information. Why do we think this is ill-formed?
Herb Sutter : we do not have technical discussions here.
Davis Herring : I'm not disagreeing with the compiler writers. Is there a difference if the language does something wrong or if it the facility doesn't exist and the users do something wrong without it.
Herb Sutter : one is a defect and the other is a hole where users may fall in.
Chandler Carruth : EWG thought this was worth moving to C++20.

Hubert Tong: this feature as it is does not say that if you have the same value you get the same specialisation.

Are we considering this motion for C++20
In favour : 39
Opposed : 14
Abstain : 21
NB objection to this poll : 2

Motion 22 has been withdrawn

Motion 23
Move to accept the changes in P1825R0 (Merged wording for P0527R1 and P1155R3) as a Defect Report and apply them to the C++ working paper.

Mike Miller : this is about additional context in which move construction can be done.

No objection to unanimous consent.
Motion passes.

Motion 24
Move to accept the changes in P1703R1 (Recognizing Header Unit Imports Requires Full Preprocessing) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 25
Move to accept the changes in P0784R7 (More constexpr containers) to the C++ working paper.

Gabriel Dos Reis : has this been implemented?
Daveed Vandevoorde : yes.

There are objections in the room.
In favour : 61
Opposed : 0
Abstain : 9
Motion passes.

- ### Library (Clow)

Marshall Clow presents. LWG is moving 34 papers, which is more than we expected.

We started the week with 52 papers scheduled. Three of these were withdrawn by the authors, but 26 more were sent our way during the week. We reviewed ~40 of them. There were a few that we decided not to move, but most of the remainder were not considered to be "unworthy"; we just ran out of time for C++20. Using Herb's metaphor, the train left the station before they could board.

Notable Accomplishments :
We moved 34 papers, and CWG moved an additional 5 that LWG had reviewed.
A partial list of the ones that we moved:
* 0553 - Bit Operations
* 0980 - Constexpr `string`
* 1004 - Constexpr `vector`
* 1065 - Constexpr `INVOKE`
* 1135 - The C++20 Synchronization Library
* 1208 - Source Location
* 0645 - Text Formatting
* 1361 - Integration of `chrono` with text formatting
* 1754 - Rename concepts to standard_case for C++20, while we still can
* 1614 - Spaceship integration in the Standard Library
* 0600 - Stop Tokens and a Joining Thread
* 0631 - Math Constants

Not moved because of time :
* 1391 - Range constructors for `string_view`
* 1394 - Range constructors for `span`
* 0288 - `any_invokable`
* 0201 - `polymorphic_value`
* 0429 - A Standard flatmap
* 1222 - A Standard flatset
* 0533 - constexpr for cmath
* 0792 - `function_ref`
* 0881 - A Proposal to add stacktrace library
* 1272 - Byte-swapping
* 0627 - Function to mark unreachable code
* and many others

There is also a series of papers all with similar titles. These propose large, mechanical changes to the library wording, while attempting not to change the meaning. The goal of these papers is to make the specification of the library sections of the standard match the guidelines in [P1369](https://wg21.link/P1369). The NBs have agreed to allow these papers to be processed after the CD is created; so these papers will be in the pre-Belfast meeting, and be updated to suggest wording changes against the CD.

* 1622 - Mandating the Standard Library: Clause 31 - Thread support library

* 1686 - Mandating the Standard Library: Clause 27 - Time library
* 1718 - Mandating the Standard Library: Clause 25 - Algorithms library
* 1719 - Mandating the Standard Library: Clause 26 - Numerics library
* 1720 - Mandating the Standard Library: Clause 28 - Localization library
* 1721 - Mandating the Standard Library: Clause 29 - Input/Output library
* 1722 - Mandating the Standard Library: Clause 30 - Regular Expression library
* 1723 - Mandating the Standard Library: Clause 31 - Atomics library

Daveed Vandevoorde : is there any concern that the NBs that do not attend might object to these massive changes to the document between the CD and the release standard ?
Marshall Clow : Herb polled NBs. One NB said we would rather not have this done before the CD, but we want it done.
Herb Sutter : we don't think there will be an issue with NBs who do not attend
if anyone raises a question, I will answer it.
Bjarne Stroustrup : could you briefly explain why you are confident that you are not introducing errors by mistake?
Marshall Clow : we will review them after they are written. They will not be in the post-Cologne mailing because I want to rebase them on the CD.

Marshall Clow continues. We have put a lot of things in the C++20 that have been a long time coming, and we have also not put in a lot of things. We ran out of time. Thank you to all the people in LWG who worked very hard. Thank you to the scribes.

LWG Motions

Motion 1

Move to apply the changes in P1724R0 (C++ Standard Library Issues to be moved in Cologne) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 2

Move to apply the changes in P1355R2 (Exposing a narrow contract for `ceil2`) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 3

Move to apply the changes in P0553R4 (Bit operations) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 4
Move to apply the changes in P1424R1 ('constexpr' feature macro concerns) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 5
Move to apply the changes in P0645R10 (Text Formatting) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Herb Sutter : thank you to everyone who worked on this, and thank you to Howard who is not here.

Motion 6
If motion 5 passes, move to apply the changes in P1361R2 (Integration of chrono with text formatting) to the working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 7
If motion 5 passes, move to apply the changes in P1652R1 (Printf corner cases in `std::format`) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 8
Move to apply the changes in P0631R8 (Math Constants) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 9

Move to apply the changes in P1135R6 (The C++20 Synchronization Library), P1643R1 (Add wait/notify to atomic_ref), and P1644R0 (Add wait/notify to atomic<shared_ptr>) to the C++ working paper.

Marshall Clow : these three papers all add similar features to different places and I thought it was important they pass or fail together.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 10
Move to apply the changes in P1466R3 (Miscellaneous minor fixes for chrono) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 11
Move to apply the changes in P1754R1 (Rename concepts to standard_case for C++20, while we still can) to the C++ working paper.

There are objections in the room.
In favor : 45
Opposed : 3
Abstain : 21
Motion passes.

Motion 12
Move to apply the changes in P1614R2 (The Mothership has Landed) to the C++ working paper.

Marshall Clow : this is a motion to apply the spaceship operator throughout the library.

No objection to unanimous consent.
Motion passes.

Motion 13
Move to apply the changes in P0325R4 (`to_array` from LFTS with updates) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 14

Move to apply the changes in P0408R7 (Efficient Access to basic_stringbuf 's Buffer) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 15
Move to apply the changes in P1423R3 (char8_t backward compatibility remediation) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 16
If Core motion 14 passes, move to apply the changes in P1502R1 (Standard library header units for C++20) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 17
Move to apply the changes in P1612R1 (Relocate Endian's Specification) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 18
Move to apply the changes in P1661R1 (Remove dedicated precalculated hash lookup interface) to the C++ working paper.

Marshall Clow : at the last meeting we adopted a paper that added a set of interfaces to the unordered containers which lets you precalculate the hashes and use them directly. People have discovered you can do all that with the existing interface. Instead of adding complexity that has no benefit we are taking these interfaces out. We apologise to any implementers who added this and now have to remove it.

No objection to unanimous consent.
Motion passes.

Motion 19
Move to apply the changes in P1650R0 (Output std::chrono::days with 'd' suffix) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 20
Move to apply the changes in P1651R0 (`bind_front` should not unwrap `reference_wrapper`) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 21
Move to apply the changes in P1065R2 (Constexpr INVOKE) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 22
Move to apply the changes in P1207R4 (Movability of Single-pass Iterators) to the C++ working paper.

Tomasz Kamiński : have we discussed that this paper changes the iterator requirements to allow single pass iterators to be move only and not forcing them to be copyable. Also, has we discussed that range view input iterators have not been adapted to take advantage of this facility.
Titus Winters : yes, this was brought up in the LEWG and the decision is still outstanding.
Tomasz Kamiński : any iterator that was move only will not work with ranges.
Herb Sutter : was this considered in LEWG ?
Titus Winters : yes, the consensus that this is likely to be a defect and we will have to deal with it in an NB comment.
Marshall Clow : this is for iterators in the range library as opposed to C++98 iterators.
Alisdair Meredith : and that means using the iterator concepts, not the iterator requirements.

Herb Sutter : technical questions are fine, but we only want to know if the topic was discussed in the subgroup.

There are objections in the room.
In favour : 39
Opposed : 0
Abstain : 31
Motion passes.

Motion 23
Move to apply the changes in P1035R7 (Input Range Adaptors) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 24
If motion 22 and 23 pass, move to apply the changes in P1638R1 (`basic_istream_view::iterator` should not be copyable) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 25
Move to apply the changes in P1522R1 (Iterator Difference Type and Integer Overflow) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 26
Move to apply the changes in P1004R2 (Making `std::vector` constexpr) to the C++ working paper.

Billy O'Neal : we have implementability concerns with motion 26 and 27. We want what is in those papers, but we don't know if the core wording is sufficient to implement them.
Christian Trott : if it turns out that it is not implementable, what is the resolution ?
Herb Sutter : we can file a NB comment.
Ville Voutilainen : we don't need an NB comment, we can do that as a bug fix internal to the committee.
Mike Miler : if it does prove to be unimplementable, will it be a DR for core or for library ?
John Spicer/Ville Voutilainen : it will be for the library.
Chandler Carruth : this was discussed extensively by implementors in SG7.

There are objections in the room
In favour : 56
Opposed : 0

Abstain : 15
Motion passes.

Motion 27
Move to apply the changes in P0980R1 (Making `std::string` constexpr) to the C++ working paper.

Jonathan Caves : the discussion from the previous motion applies here too.

There are objections in the room
In favour : 55
Opposed : 0
Abstain: 15
Motion passes.

Motion 28
Move to apply the changes in P0660R10 (Stop Token and Joining Thread, Rev 10) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 29
Move to apply the changes in P1474R1 (Helpful pointers for `ContiguousIterator`) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 30
Move to apply the changes in P1523R1 (Views and Size Types) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 31
Move to apply the changes in P0466R5 (Layout-compatibility and Pointer-interconvertibility Traits) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Motion 32

Move to apply the changes in P1208R6 (Adopt source_location for C++20) to the C++ working paper.

No discussion.
No objection to unanimous consent.
Motion passes.

Herb Sutter : thank you to LWG.

WG21 Motion

Motion 1
Move to appoint an editing committee composed of Daniel Kruegler, Davis Herring, Nina Ranns, and Ville Voutilainen to approve the correctness of the C++ working paper as modified by the motions approved at this meeting, and to direct the Convener to transmit the approved updated working paper for CD ballot.

Alisdair Meredith : what is our time table to be able to act on NB comments ?
Herb Sutter : will we run the CD ballot between the meetings.

No objection to unanimous consent.
Motion passes.

- ### Direction Group (Hinnant)

No report.

8. Closing activities

8.1 Issues delayed until today

No discussion.

8.2. PL22.16 motions, if any

No discussion.

9. Plans for the future (PL22.16)

9.1 Next and following meetings

Herb Sutter presents. This is the biggest release since C++11. It is going to make a big difference to our community.
We wrote down the schedule this time, thank you to Ville for pointing out the need to do so. We tried to move TS's as early as possible, we cut off new features earlier. The library was able to react to new features. We are doing things more orderly.

Thank you to Nico for hosting Cologne.

2019-11-04/09: Belfast, Northern Ireland (N4782)

Jamie Allsop presents. There will be an ACCU conference after the meeting.
Thank you to all the sponsors. Hosting is getting increasingly expensive. Please sponsor if you can.
Jamie presents Belfast.
Registration is open.

Nico Josuttis : let us know if there are any issues from Brexit before the meeting.
Herb Sutter : please make sure you have investigated any issues in the places you are travelling to. This is not organisers responsibility. Let us know if you need visa support. The hosts might not always be able to report issues.
Attila Feher : is it possible that we will need visas ?
Herb Sutter : we don't know.
Timur Doumler : quite a few of us will be staying at the conference hotel during ACCU meeting and WG21 meeting. How do we handle the hotel for the whole stay ?
Jamie Allsop : if you go to WG21 you can also register for ACCU. If you haven't heard about your paper, you will hear soon.

2020-02-10/15: Prague, Czech Republic (N4817)

Hana Dusíková presents. Please register with the hotel as soon as possible so we have an idea about numbers of attendees. Any questions, please let me know.
Please note we do not use euros yet.
Alisdair Meredith : is this the meeting where we will vote out the CD ?
Hana Dusíková : yes. We will take a photo during the social meeting.

2020-06-01/06: Varna, Bulgaria
Stefan Ivanov presents the location. There will be more details in the post-Cologne mailing.

There will be a conference on computer graphics, Total Chaos, on the Friday and Saturday before the meeting. For more information please contact Vassil Vassilev.
Thank you to our sponsors.
Nico Josuttis : this meeting is during a European holiday so beware of travel pans.

2020-11 New York (tentative)
2021-02 Kona, Hi, USA

9.2. Mailings

2019-08-05: Post-Cologne
2019-10-07: Pre-Belfast

Hal Finkel presents. If you haven't signed the attendance sheet please do so. Please upload your papers which are on the motions page to the post meeting mailing management system. This is no longer done automatically. If you upload it yourself, it will speed up the process and it will help associate you as the author with that paper in the paper handling system.

10. Adjournment

Jens Maurer : there are groups that want to meet after the end of the plenary.

Ville Voutilainen : show of hands who can attend a session this afternoon. We have a quorum. EWG will start at 1:30PM.

Mike Miller : CWG will start at 1:30PM.

Jens Maurer : thank you to the projector carriers. We do not need them in Belfast. We will let you know if we need them in Prague.
Attila Feher : are we carrying the cables too ?
Jens Maurer : please carry all the cables. Don’t take the german power cables.

Walter Brown presents.
Thank you the host and the sponsors.
Thank you to everyone that participated and those who helped us participate.

PL22.16 motion to adjourn.
Marshall Clow moves. Barry Hedquist seconds.
Approved by unanimous consent.

John Spicer adjourns the meeting at 12:08 pm UTC+2.

11. Attendance

Name	Representing	NB
Aaron Ballman	GrammaTech Inc	
ADAM David Alan Martin	MongoDB Inc	
Adrian Cowan		
Adrien Hamelin		
Agustin Berge	Louisiana State University	
Aleksandr Fokin	Yandex	RU
Alex Wells	Intel Corporation	
Alexandru Croitor	The Qt Company	
Alexandru Voicu	AMD	
Alisdair Meredith	Bloomberg	
Andreas Bemitzke		
Andreas Fertig		
Andreas Reischuck	HicknHack Software GmbH	
Andreas Weis	BMW AG	DE
Andrew Lumsdaine	Pacific Northwest National Laboratory	
Andrew Soffer	Google	
Andrew Sutton	University of Akron	
Andrey Erokhin		
Andrzej Krzemienski	Sabre	PL
Anton Polukhin	Yandex.Taxi	RU
Attila Feher	Bloomberg	
Axel Naumann	CERN	CH
Barry Hedquist	Perennial	

Name	Representing	NB
Barry Revzin	Jump Trading	
Ben Boeckel	Kitware, Inc.	
Benjamin Saks	Saks & Associates	
Bernhard Manfred Gruber	CERN	
Billy Baker	FlightSafety International	
Billy O’Neal	Microsoft Corporation	
Bjarne Stroustrup	Morgan Stanley	
Boris Kolpackov		
Botond Ballo	Mozilla	CA
Bruno Lopes	Apple	
Bryan St. Amour		CA
Bryce Adelstein Lelbach	NVidia Corporation	
Bryce Kille		
Caleb Sunstrum	Edison Design Group	
Casey Carter	Microsoft Corporation	
Chandler Carruth	Google	
Chanyoung Park	Facebook	CA
Chris Kennelly	Google	
Chris Kohlhoff	**clearpool.io**	GB
Christian Trott	Sandia National Laboratories	
Christof Meerwald	Programming Research Ltd	
Christopher Di Bella	Codeplay	GB
Christopher Earl	Lawrence Livermore National Laboratory	
CJ Johnson	Google	
Clive Pygott		

Name	Representing	NB
Conor Hoekstra	Amazon Corporate LLC	
Corentin Brauge	Microsoft Corporation	
Corentin Jabot		FR
Cristian Adam	The Qt Company	
Damien Lebrun-Grandie	Oak Ridge National Laboratory	
Daniel Krügler		
Daniel Sunderland	Sandia National Laboratories	
Daniela Engert	GMH Prüftechnik GmbH	
Daveed Vandevoorde	Edison Design Group	
David Goldblatt	Facebook	
David Hollman	Sandia National Laboratories	
David Olsen	NVidia Corporation	
David Sankel	Bloomberg	
David Stone	Uber	
Davis Herring	Los Alamos National Laboratory	
Dawid Pilarski		PL
Detlef Vollmann	Vollmann Engineering	CH
Dietmar Kühl	Bloomberg	
Duncan Exon Smith	Apple	
Elias Kosunen		
Eric Niebler	Facebook	
Erich Keane	Intel Corporation	
Espen Harlinn		NO
Eugenio Bargiacchi	Vrije Universiteit Brussel	
Fabio Fracassi		DE

Name	Representing	NB
Federico Kircheis		
Florian Sattler		
Floris Bob van Elzelingen		
Frank Birbacher	Bloomberg	
Gabriel Dos Reis	Microsoft Corporation	
Geoffrey Romer	Google	
Gor Nishanov	Microsoft Corporation	
Graham Lopez	Oak Ridge National Laboratory	
Guy Davidson	Creative Assembly	GB
Hal Finkel	Argonne National Laboratory	
Hana Dusíková	AVAST	CZ
Hannes Hauswedell	Freie Universität Berlin	
Hans Boehm	Google	
Hartmut Kaiser	Louisiana State University	
Herb Sutter	Microsoft Corporation	
Hubert Tong	IBM Corporation	CA
Iain Sandoe		
Ievgen Polyvanyi		
Ilya Burylov	Intel Corporation	
J. Daniel García	University Carlos III of Madrid	ES
Jade Alglave	ARM Ltd	
James Dennett	Google	
James Touton	Blizzard	
Jamie Allsop	**clearpool.io**	GB
Jan Tusil	Runtime Verification Inc	

Name	Representing	NB
Jason Merrill	Red Hat Inc	
Jayesh Badwaik	University of Würzburg	
Jean-Francois Bastien	Apple	
Jean-Paul Rigault	Université de Nice S.A.	FR
JeanHeyd Meneide		
Jeff Garland	Crystal Clear Software	
Jeff Snyder	PDT Partners	GB
Jeffrey Mendelsohn	Bloomberg	
Jens Gustedt		FR
Jens Maurer	Edison Design Group	
John Franklin Richard		
John Lakos	Bloomberg	
John McFarlane		GB
John Spicer	Edison Design Group	
Jolanta Opara		PL
Jonathan Caves	Microsoft Corporation	
Jonathan Madsen	Lawrence Berkeley National Laboratory	
Jonathan Müller		
Jonathan Wakely	Red Hat Inc	
Jonny Weir	clearpool.io	
Jorg Brown	Google	
Joshua Berne	Bloomberg	
Juan Alday	GreenWireSoft	
Kilian Henneberger		
Klaus Wittlich	SAE IT Systems	

Name	Representing	NB
Lars Gullik Bjønnes	Cisco Systems Inc	
Lawrence Crowl	Perennial	
Lewis Baker	Facebook	
Li-Ta Lo	Los Alamos National Laboratory	
Lisa Lippincott	Tanium	
Loïc Joly	Sonar Source	FR
Łukasz Bondyra	Motorola Solutions	PL
Łukasz Wojakowski		PL
Maged Michael	Facebook	
Marc Mutz	KDAB	
Marcin Grzebieluch	Sii Poland	PL
Marco Foco	NVidia Corporation	
Mark Zeren	VMware Inc	
Marshall Clow	C Plus Plus Alliance Inc	
Mateusz Pusz	EPAM Systems Inc	
Matt Calabrese	Google	
Matthew Butler	Laurel Lye	
Matthias Gehre		
Matthias Kretz	GSI	DE
Matti Rintala		FI
Michael Florian Hava		
Michael McLaughin		
Michael Spencer	Apple	
Michael Spertus	Symantec	
Michael Wong	Codeplay	CA

Name	Representing	NB
Michał Dominiak	NVidia Corporation	
Miguel Ojeda		
Mihail Mihaylov	VMware Inc	BG
Mikael Kilpeläinen	CryptoTec	FI
Mingxin Wang	Microsoft Corporation	
Nathan Burgers	Bloomberg	
Nathan Myers	Maystreet	
Nathan Sidwell	Facebook	
Nathaniel Goodspeed	Linden Research, Inc	
Neil Horlock		GB
Nevin Liber	Argonne National Laboratory	
Niall Douglas		
Nicolai Josuttis		DE
Nicolas Lesser	Albert-Ludwigs-Universität Freiburg	
Nina Dinka Ranns	Edison Design Group	GB
Odin Holmes	Auto-Intern GmbH	
Olga Arkhipova	Microsoft Corporation	
Olivier Giroux	NVidia Corporation	
Pablo Halpern	Halpern-Wight Inc	
Pal Balog		
Paolo Carlini	Oracle	
Pascal Menuet		FR
Paul McKenney	IBM Corporation	
Paul Preney	University of Windsor	CA
Peter Gottschling		DE

Name	Representing	NB
Peter Sewell	University of Cambridge	
Peter Sommerlad	HSR	CH
Phil Nash		GB
Philipp Krause	Albert-Ludwigs-Universität Freiburg	
Phillip Ratzloff		
Richard Corden	Programming Research Ltd	
Richard Kaiser		
Richard Smith	Google	
Robert Douglas	Aquatic Group	
Robert Schumacher	Microsoft Corporation	
Robert Steagall	KEWB Computing	
Roger Orr		GB
Rostislav Khlebnikov	Bloomberg	
Ruslan Arutyunyan	Intel Corporation	
Ryan McDougall	Aurora Innovation	CA
Sara Saa		
Sebastian Büttner		
Sebastian Messmer	Facebook	
Sergei Murylev	Yandex	
Shuo Feng Liu	IBM Corporation	CA
Simon Roth		
Sophia Poirier	Apple	
Stanimir Lukanov	VMware Inc	BG
Stefan Ivanov	Chaos Group	BG
Thomas Grützmacher		

Name	Representing	NB
Thomas Rodgers	Red Hat Inc	
Thomas Scogland	Lawrence Livermore National Laboratory	
Tim Northover	Apple	
Timothy Costa	NVidia Corporation	
Timur Doumler	Jetbrains	GB
Titus Winters	Google	
Tobias Loew		
Tom Honermann	Synopsys Inc	
Tomasz Kamiński	Sabre	PL
Victor Zverovich	Facebook	
Ville Voutilainen	Plum Hall Inc	
Vincent Reverdy	Paris Observatory	FR
Vito Giovanni Castellana	Pacific Northwest National Laboratory	
Vittorio Romeo	Bloomberg	
Volker Dörr		DE
Volker Vovula		
Wagoner Larry	United States Dept of Defense	
Walter Brown	Brown	
Wesley Maness	Schonfeld Tools LLC	
Will Deacon	ARM Ltd	GB
William Miller	Edison Design Group	
William Seymour	Seymour	
Wim Leflere		
Wyatt Childers	Lock3 Software	
Xiao Shi	Facebook	

Name	Representing	NB
Zachary Henkel	Microsoft Corporation	