

WG21 2019-02 Kona Record of Discussion

ISO/IEC JTC1 SC22 WG21 P1611 — 2019-03-10

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18-23 February 2019, Kona, HI, USA

Chair: John Spicer

1. Opening activities

John Spicer opened the meeting at 8:34 UTC-10.

1.1 Opening comments, welcome from host

Thomas Plum welcomes the group.
Herb Sutter thanks the sponsors.
Jens Maurer presents the meeting amenities.

John Spicer presents the meeting 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 WG21 Practices and Procedures, and Code of Conduct](#)

John Spicer presents the meeting guidelines. Please take the time to review these documents.

If you have any questions, or want to report a code of conduct issue, please talk to one of the officials.

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, intermediate progress reports, no quoting people without their permission. If you take pictures, avoid taking pictures of people's screens. If you do post something, post it after the meeting.

Hal Finkel presents. Please sign in on the membership list which is outside of this room. If your name is not on the list, or if there is anything wrong with the information on the membership list, please come and see me. Do wear your name tags to help scribes identify you.

We are moving to an automated paper number generating system. On the wiki there will be a link to the page for getting the paper number. You can still use the old system which will e-mail you a paper number.

We also have a new paper numbering system. The link is on the wiki. You need a login to isocpp.org. When you register, send me and Herb Sutter the login name so we know who you are. When you login, you will have an option to request a paper number. We are still trialing out this system. If you have any issues, please let me know.

Botond Ballo: I'm logged in, but I'm not getting the form.

Hal Finkel: You are probably not on the list. Email me and Herb your login name.

Hal Finkel: The instructions on how to use the numbering system are on the wiki.

Herb Sutter: There are no personally identifiable information on the isocpp site. The login exists only to prevent spamming.

John Spicer presents the voting rights.

1.4 Introductions

Officers and WG 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 and reminds everyone that we start half an hour earlier than usual. The meeting will finish no later than 1:30pm on Saturday, but WGs may continue working.

John Spicer presents the meeting goals.

The primary goals of this meeting will be:

- Work on C++20 features

Additional, lower-priority goals include:

- Merge modules into Working Draft [P1103R2](#)
- Merge the Coroutines TS into the C++20 working draft, continuing to refine it in the IS draft and adopting its issues list into the main issues lists

PL22/16 motion to approve the meeting agenda.

Marshall Clow moves. Barry Hedquist 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	N4799	N4800
Coroutines TS	None	None
Networking TS	None	None
Library Fundamentals TS	N4787	N4786

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

PL22/16 motion to approve the PL22.16 minutes of the previous meeting.

Marshall Clow moves, Aaron Ballman seconds.

The motion is unanimously approved by PL22/16.

Meeting	Minutes
WG21 San Diego	N4790 N4802
WG21 pre-Kona administrative telecon	N4801

Hubert Tong: the number for the latest version of San Diego minutes is wrong. It should be N4802.

John Spicer calls for WG21 motion to approve the minutes of the previous meetings with the correction to the San Diego minutes number.
The motion is unanimously approved by WG21.

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

Additional report from the Direction Group.

Howard Hinnant presents. Direction Group is interested in long term goals for C++. We have a standing paper in the mailing, please read it. If you want to contact us, please contact us individually or through our mailing list.

Bjarne Stroustrup presents. Please do read the P0939 document. Please look at the big picture, and not just your own interests. The best is the enemy of the good. General strategy in C++ is to take the first steps, see what happens, and then improve.

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 presents meeting room schedule. The schedule can be found on the wiki. There is one page for the room assignments, and one for the evening sessions.

Jens goes through room assignments.

Jens presents the evening sessions.

- Monday:
 - SG15 Modules Tooling Interactions (Titus Winters and Bryce Adelstein Lelbach)
- Tuesday:
 - LEWGI Linear Algebra Requirements (Bryce Adelstein Lelbach)
 - SG14 Freestanding Implementations (Michael Wong; backup: Ville Voutilainen)
- Wednesday:
 - Coroutines informational session (Ville Voutilainen): For a larger group, summarizing the results of EWG discussion and specifically the "late-sized type" design question and implementation alternatives
 - LWG Issues processing in Conf. Room 3 (Marshall Clow)
- Thursday:
 - SG13 Audio Basics [informational session] (Roger Orr)
 - Editorial meeting in Conf. Room 6 (Richard Smith)
- Friday: no evening sessions

Ville Voutilainen: Is the chairing of the SG14 evening session still as planned ?

Herb Sutter: Yes

Herb Sutter presents C++ IS schedule. Updates are in P1000. This meeting is when we decide feature set of C++20. In Cologne we will start the CD ballot. This is not a meeting where we will look at new proposal for C++20. This is the first meet-

ing where we have multiple features which have existing implementations before being adopted into the working draft, including modules and co-routines. Thank you to those who put in the work.

Will my paper make C++20? If CWG or LWG approve it in this meeting, and if these groups have enough time to review your paper here or in Cologne. CWG is on schedule to review all the papers, LWG has a lot of work to do and may not be able to review all the papers. If LWG becomes a bottleneck, we will have to look into what we can do. If LWG sees more paper coming into LWG queue, we have asked LEWG to create a priority queue of papers.

Marshall Clow: Review is a slow work and it takes time.

David Hollman: Are big papers with less wording likely to spend less time in review ?

Marshall: Yes, the works is relevant to the wording size, not the feature size.

Pablo Halpern: What is reasonable to change between CD and WP ?

Herb Sutter: We do not add features after CD. The only change are bug fixes for the wording.

Davis Herring: If you have wording coming in, perhaps someone might want to volunteer to help before going in front of the whole group.

Bryce Adelstein LeBlach: Can Marshall and Titus comment on the impact of improving the networking paper?

Titus: we do not have time to review it to the level that is necessary to include it in the C++20.

Jorg Brown: Should a testing suite for compliance be considered by the committee ?

Herb Sutter: We have considered this before, but we do not generally do that. Someone would have to propose it with detailed description of how we should actually do it, including how we would absorb the extra effort it would take.

Standard C++ foundation has purchased some projectors which will travel from meeting to meeting. Looking for volunteers to carry these projectors to the meetings and look after them during and in-between the meetings

Meeting adjourned at 9:44 UTC-10

7. Review of the meeting (Saturday 8:00 AM)

John Spicer opened the meeting at 8:03 am UTC-10.

WG and SG status and progress reports.

- **SG5: Transactional memory (Boehm)**

Hans Boehm presents. SG5 has not met this week.

- **SG6: Numerics (Crowl)**

Lawrence Crowl presents. SG6 met for 2.5 days, one day was a joint meeting with SG14 on linear algebra. We passed on several papers and have been working on several more. See the wiki for the minutes.

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

Chandler Carruth presents. SG7 met for an afternoon and made a lot of progress. The main topic was api design pattern used for next iteration of reflection which moves it into constexpr programming model instead of a template meta programming model. We have not reached a firm decision yet. We have also discussed a paper for replacing the offsetof() macro with a non macro.

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

Roger Orr presents. SG13 had an informational evening session about audio. We also had an afternoon session where we looked at an early paper for audio and found a large number of things we need to look at further. It was a good start. There was no further progress at this meeting on 2D graphics.

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

Gabriel Dos Reis presents. SG12 met for three days, two of which were in joint session with WG23. We also looked at Misra material. Michael Wong chaired those two days.

Michael Wong presents. We looked at the WG23 vulnerability paper, and about 75% of the work is now done. Once we finalize that, we will look at the Misra document.

Ville Voutilainen: Is there a Misra specification coming to C++ ?

Michael Wong: We can't say, but there is Misra work in progress.

Ville Voutilainen: If such a specification would appear, what version of C++ standard would it be based on ?

Michael Wong: Hypothetically, C++11, C++14, and C++17.

Gabriel Dos Reis presents: On Friday we looked at two papers. One on signed arithmetic overflow, with suggestion to make it implementation defined behavior. We thought it was also education related, so we forwarded it to SG20. It was also forwarded to SG6. The other paper was on pointer provenance and it was mostly informative.

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

Michael Wong presents. SG14 had a face to face meeting discussing linear algebra. We also had an evening session organized by Bryce where we discussed the history paper. Thank you to Bryce Adelstein Lelbach. We also discussed the Matrix Template Library. It was a retrospective discussion on what was done right and what was done wrong. Thank you to Andrew Lumsdaine.

We looked at two additional papers about the layering plan for linear algebra and the actual design itself.

We will continue to have the face to face sessions at the next three meetings. Thank you to my scribe, Patrice Roy.

- **SG15: Tooling (Adelstein Lelbach)**

Bryce Adelstein Lelbach presents. SG15 had a couple of tele-cons to talk about modules and tool interaction. For the near future that will be the primary focus. We met on Friday evening to discuss this topic, and we will be looking into creating a technical report on the C++ eco-system. This TR would cover best practice on how tools, build systems, and compilers can interoperate in a modular world. We haven't figured out all the details yet. The first step is to work on a scoping document and a set of use cases that are important and which we want to address in the TR.

We will continue to have tele-cons, probably twice a month from now until the Cologne meeting.

We also met on Friday afternoon, where we talked about module BMI abi interactions and a little about the TR.

Thank you to Titus for all his work.

- **SG16: Unicode (Honermann)**

Tom Honermann presents. We have two papers on the motions list. One of them is P1041 which mandates the encoding of `char16_t`/`char32_t` literals. The other is P1139 which aligns some of the wording in the standard with the unicode standard.

We met on Friday morning and discussed a couple of papers. First was about compile time regular expressions. We provided guidance on how to align that with the unicode standard on regular expression. The biggest challenge is that, while there are many regular expression syntaxes available, the ones that are standardized do not meet the unicode standard. If you are passionate about regular expressions or have some relevant experience, we would appreciate your input.

The second paper we looked at was about transcoding and transliteration requirements.

Thank you to the scribe.

- **SG1: Concurrency (Giroux)**

Hans Boehm presents. Olivier Giroux was unable to attend, so Michael Garland stepped in as the chair at this meeting.

SG1 met Monday to Friday and discussed 23 papers.

Papers for C++20:

- P0660: A cooperatively interruptible joining thread (to LWG)
- P1152: Deprecating volatile (to EWG)

SG1 supports withdrawing the original Concurrency TS.

Forwarding to LEWG for Concurrency TS 2:

- P1202: Asymmetric Fences

Refinements to Executor Facilities

Forwarding to LEWG:

- P1348: An Executor Property for Occupancy of Execution Agents
- P1322: Networking TS enhancement to enable custom I/O executors

Reviewed work in progress on:

- P1019: Integrating Executors with Parallel Algorithms
- P1341: Unifying Asynchronous APIs in the Standard Library
- P1436: Executor properties for affinity-based execution

Other Work in Progress

- P0876: fiber_context - fibers without scheduler
- P0652: Concurrent associative data structure with unsynchronized view
- P0387: Memory model issues for concurrent data structures
- P1382: volatile_load<T> and volatile_store<T>
- P1372: Giving atomic_ref ... customization points for non-lock-free implementation
- P1367: Not all agents have TLS

Please talk to me if you have any question on these papers. Thank you to Michael Garland for chairing the meeting.

- **SG17: EWG Incubator (Bastien)**

JF Bastien presents. We met for three days. We saw 27 papers, 5 were forwarded to EWG, 3 do not have consensus to move forward, the rest received feedback. 2 have been forwarded to other groups for additional feedback. The group oscillated between 8 and 19 people.

- **SG18: LEWG Incubator (Adelstein Lelbach)**

Bryce Adelstein Lelbach presents. Sg18 met for 3.5 days. The group saw 43 papers. 30 received direction review, 6 design review, and 7 had design feedback.

No consensus to spend more time: 7
Sent to LEWG for C++20: 1
Ready for LEWG(I) design review for C++23: 11
Referred to EWGI: 1
Proceeds in other SG: 7
Further refinement in LEWGI needed: 16

Design feedback was given on:

- Numerics TS (number types, etc)
P1438, P0828, P0037, P0554, ...
- P1385 Linear Algebra
- P1386 Audio

LEWGI looked at:

- P0829 Freestanding Reorganization
- P0959 std::uuid
- P0447 std::colony
- Concurrency TS v2
 - P0260 Concurrent Queues
 - P0261 Distributed Counters
- Text/Strings:
 - P1433 Compile Time Regular Expressions
 - P1228 Efficient String Concatenation
 - P1479 std::ostringstream Wrapper
 - P1402 std::cstring_view
- Casey Ranges Papers
 - P1456 Move-only Views
 - P1474 std::to_address(ContiguousIterator)
 - P1419 std::ranges::static_extent
- Networking TS papers
 - P1100, P1145, P1133, P1322, P1442

Thank you to everyone involved.

Pablo Halpern: How are incubators related to other study groups. If someone had a concurrency paper, does it go to SG1 then LEWGI or the other way around.

Herb Sutter: LEWGI and EWGI are study groups. All the study groups are peers. It's there first stage before going to LEWG/EWG, and then finally LWG/CWG. Incubators would look at things that don't already belong to another study group. If a study group progresses something, by default it's to LEWG/EWG. If incubators have paper that needs domain expertise, they can refer the paper to those groups before forwarding to LEWG/EWG.

Bryce Adelstein Leibach: For example, the reason we looked at Concurrency TS papers is because we offered the authors the opportunity to get feedback. Those papers are in LEWG queue, but LEWG wouldn't have had time to look at them this meeting.

Alan Talbot: Is there a record of the discussion and the rationale for each of the papers LEWGI looked at ?

Bryce Adelstein Leibach: Yes. They all have chair notes and a summary of discussion, and there is a guidance provided to the authors, including interpretations of what the polls mean.

That won't happen until after the meeting.

- **SG19: Machine Learning (Wong)**

Michael Wong presents. Going back to SG14, there was an evening session that dealt with the freestanding implementation. Thank you to Ville for chairing that. The discussion continued within SG14 to decide what embedded within C++ means. SG19 had the first face to face meeting here. There was a good number of participants in the room. We discussed a layering paper on how to have machine learning features added. Andrew Lumsdaine presented the Boost Graph Library. We gave feedbacks to the linear algebra group on what machine learning means. The plan is to continue the all day meetings - morning being SG14 with linear algebra, and afternoon being SG19. We expect more people attending the machine learning part at the European meetings.

We still meet regularly on-line. SG14 meets on the first Wednesday of the Month. SG19 is polling for the next meeting schedule, but also meets every month.

- **SG20: Education (van Winkel)**

JC van Winkel presents. SG20 had the first face to face meeting. There was about 15-25 people, including some high school students. Met all day Thursday. First paper "evaluated" for teachability / EDU value ([P1279](#)). Hailed Gor for the use of a Gor table in [P1362](#) section 4.4 ("Are coroutines expert only feature?"). We would like to see more of those.

We discussed the state of the first standing paper ([P1389](#)) and set the future course:

- no more strict separation in novice/intermediate/advanced learner for guidelines.
- grouping facilities into "notions"
- make a dependency graph of notions so you can see when you should learn what
- adopt a more TR-like approach for better cohesion. We will have papers that propose to make changes to our standing paper.

We will be meeting monthly via tele-con. We will meet face to face in Cologne. Thank you to Patrice Roy for taking minutes.

- **Evolution (Voutilainen)**

Ville Voutilainen presents.

Contracts:

Discussed multiple proposals to change how assumptions work (namely [PD]1290 and P1429), and a proposal to yank contracts out of the WP ([PD]1426).

The status quo stands, the proposals for other solutions have no consensus. A proposal to rename expects/ensures to pre/post was approved.

Modules:

There was a highly useful Tooling SG evening session on modules, build systems, and more. Evolution approved D1498, Constrained Internal Linkage for Modules. From the paper, "The overarching principle is that internal linkage names may only be used within a context that is defined to remain local to the translation unit for importable translation units." This is expected to solve our name look up problems.

Coroutines:

Reviewed P1430, First-class symmetric coroutines in C++, P1471R0, The trouble with coroutine_traits, P1477R0, Coroutines TS Simplifications. No consensus for change.

"Why is it moved again without new information?" - We have new information. The new information is that we have reviewed alternative designs, and Evolution's decision to merge is unchanged. Evolution's stance has remained the same for years. Evolution decided to merge Coroutines into C++17; a larger group, at the time, chose a TS. Evolution has done its due diligence, and reviewed various alternative approaches.

Compile-time programming facilities:

P0784R5, More constexpr containers, was approved for C++20 with a tweak; non-transient allocations are not yet ready.

P1306, Expansion statements, was approved for C++20.

Spaceship operator:

P1185R1 was approved for C++20. Defaulting a <=> defaults ==, even if <=> is deleted.

P1186R1 was approved for C++20 with a tweak; synthesize strong and weak ordering only from == and <.

Everything else:

P1381, Reference capture of structured bindings, was approved for C++20 (value capture was approved before).

P1331, Permitting trivial default initialization in constexpr contexts, was approved for C++20. This means that value-initialization is no longer mandatory.

P0593R3, Implicit creation of objects for low-level object manipulation, was approved for C++20. It does require LEWG review, though.

P1143R1, Adding the constexpr keyword, was approved for C++20. The facility provides guaranteed constant initialization of variables that are not themselves constant.

D1152R2, Deprecating volatile, was approved for C++20.

P1155R2, More implicit moves, was approved for C++20.

P1099R3, Using enum, was approved for C++20. This introduces a new using declaration that brings scoped enumerators into the current scope.

Paren-initializing aggregates:

This (P0960) was approved earlier by EWG. The whole notion of being able to initialize aggregates from a parenthesized list of values has been a rather bumpy ride. Many thanks to Thomas Köppe for championing the wording.

Thanks to Juan Alday for scribing all week.

- **Library Evolution (Winters)**

Titus Winters presents. 53 papers reviewed (64 last time), 15 papers left unreviewed (~15 last time) of which ~1 that's prioritized for C++20
Combined with LEWGI: 96 papers

Policy changes discussed: When do we mark constructors explicit? (paper promised). How absolute is the Lakos rule?

Forwarded to LWG for IS:

Text formatting (std::format)

P0645 Text Formatting

P1361 Integration of chrono with text formatting

Ranges and Algorithms:

P1391 Range constructor for std::string_view

P1206 ranges::to: A function to convert any range to a container

P1394 Range constructor for std::span

P1035 Input range adaptors

P1456 Move-only views

P1207 Movability of Single-pass Iterators

P1223 find_backward

Modules:

P1502 Minimal standard library modules for C++20

Spaceship:

P0891 Make strong_order a Customization Point!

P0790 Effect of operator<=> on the C++ Standard Library

P1189 Adding <=> to library

Ville Voutilainen: Regarding the Modules part, is that just reserving ground for modules names, but not introducing any modules ?

Titus Winters: The two things that are added in this paper: we reserve the right for modules names that look like std as well as carving out some space for non std

vendor extension. Secondly, we require that all C++ headers that are not wrapped in C headers must be able to be imported in a modular fashion.

John Lakos: What about transitive includes where C++ header includes a C header ?

Titus Winters: That is an EWG problem. The places where this is contentious is when you have macros that affect the meaning of your C++ standard, C or posix library.

John Lakos: How many people will be affected by this?

Titus Winters: The implementors and the people who have deployed this probably have higher build hygiene than most. We don't think this will be a problem. Places where we think this may be a problem are places where you already have ODR problems.

Gaby Dos Reis: This paper says how to write your libraries, there are no modules introduced.

Titus continues.

New Types:

P1208 Adopt source_location

P1222 A Standard flatset

P1293 ostream_joiner

P0660 Stop Tokens and a Joining Thread

P0288 unique_function: a move-only std::function

P0448 A stringstream replacement using span as buffer

P1132 out_ptr - a scalable output pointer abstraction

Misc:

P1328 Making std::type_info::operator== constexpr

P0466 Layout-compatibility and Pointer-interconvertibility Traits

P1355 Exposing a narrow contract for ceil2

P1374 Resolving LWG #2307 for C++20: Consistently Explicit Constructors

P1423 char8_t backward compatibility remediation

P0798 Monadic operations for std::optional

P1466 Miscellaneous minor fixes for chrono

P1227 Signed ssize() functions, unsigned size() functions

P0408 Efficient Access to basic_stringbuf's Buffer

P0553 Bit operations

P1419 A SFINAE-friendly static_extent trait

Forwarded to LWG for C++ Next:

P1393 A General Property Customization Mechanism

Forwarded to LWG for LFTS3:

P0843 static_vector

P0052 Generic Scope Guard and RAII Wrapper for the Standard Library

Forwarded to LWG for SD-8:

We assume users are not relying on "friend"-ing standard library facilities.

Discussed but not forwarded:

P1072 `basic_string::resize_default_init`

P1369 Guidelines for Formulating Library Semantics Specifications (we liked it, but doesn't require LEWG).

P1453 Modularizing the Standard Library is a Reorganization Opportunity (decided on a direction)

P1411 Please reconsider `<scope>` for C++20

P1473 Shadow namespaces (concerned about experience and time before the IS)

P1410 Remove deprecated `stringstream` (concerned about unnecessary impact on "working" code)

P0813 `construct()` shall Return the Replaced Address (concerned about changing the API of Allocator, suggestion that this needs CWG resolution)

P1496 Formatting of negative zero (not convinced this needs handling by us directly)

Thank you to Jonathan Coe for scribing.

- **Core (Miller)**

Mike Miller presents. CWG spent all the time processing C++20 papers, there was no issues processing. We will do issues processing this afternoon after plenary. We plan 4 tele-cons for issues processing between now and the Cologne meeting.

There are issue resolutions that will be moved at this meeting which were approved previously at San Diego or at a tele-con.

CWG nearly managed to go through the backlog, but there are still a couple of papers we didn't get to. We looked at one or two additional items that were forwarded from EWG because they were small or urgent.

One paper that was approved for C++20 did not make it on the straw poll page due to a clerical error - P1161R3. We expect to move it in Cologne.

CWG has 15 motions today, including Coroutines. EWG once again re-affirmed their support for the coroutines proposal and CWG will be bringing that as a motion. CWG spent a large part of the week on the modules proposal. We will be moving that today.

We also spent a lot of time on the NB comments for the Reflection TS, and we have approved all of the proposed responses, with a few changes. We will be moving those responses today and asking the committee to direct the convener to put it out for publication as edited by the changes we approved this week.

We looked at one major proposal that we are not bringing forward because we didn't have time to finish the review. This is CTAD for alias templates. It's a very complicated specification and requires a lot of review time. We will continue to review this between meetings if necessary, and in Cologne.

I would like to draw attention to one issue we are not moving at this time, but it is something that might be a surprise. If you have a position, please make it known.

This is issue 2382. If a new expression has an array type, the actual allocated space that is requested from operator new can be larger than the size of array that is being allocated. If you have the no allocation form of placement new, the current

standard says that the implementation is also allowed to use this additional overhead. That's surprising to some people. The proposal is to exempt the no allocation form of placement new from the array allocation overhead. We will probably be bringing the motion in Cologne. If you have any thoughts about it, let us know.

John Spicer reminds the group on voting rules.

CWG Motions

Motion 1

Move to accept as Defect Reports all issues in [P1358R0](#) (Core Language Working Group "ready" Issues for the February, 2019 (Kona) meeting) and apply the proposed resolutions to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes

Motion 2

Move to accept as Defect Reports all issues in [P1359R0](#) (Core Language Working Group "tentatively ready" Issues for the February, 2019 (Kona) meeting) and apply the proposed resolutions to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 3

Move to accept as a Defect Report and apply the changes in [P1286R2](#) (Contra CWG DR1778) to the C++ working paper.

Aaron Ballman: This is something that is being relaxed in the language. SG12 looked at this, and this can cause a potential issue where the meaning of the program silently changes. We didn't think this was a problem.

Herb Sutter: Did this go to EWG and did you consider this ?

Ville Voutilainen: No

Gabriel Dos Reis: When we adopt this motion, there shouldn't be a problem. This can only be problem in the transition period. We looked into this and didn't find any alternative that is acceptable. People need to be aware of this, but we don't think this is a problem

Ville: We didn't look into this at this meeting because there was no request to do so.

Gaby: We were told EWG looked at it at previous meetings.

Ville: Yes. I got the impression that SG12 didn't deem this issue to be evolutionary.

No objection to unanimous consent.

Motion passes.

Motion 4

Move to apply the changes in [P1091R3](#) (Extending structured bindings to be more like variable declarations) to the C++ working paper. *[Note that this paper is modified by the next motion.]*

Mike Miller: the next motion relaxes the constraint introduced here.

No objection to unanimous consent.

Motion passes.

Motion 5

Move to apply the changes in [P1381R1](#) (Reference capture of structured bindings) to the C++ working paper. *[Note that this paper assumes that the preceding motion passes.]*

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 6

Move to apply the changes in [P1041R4](#) (Make char16_t/char32_t string literals be UTF-16/32) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 7

Move to apply the changes in [P1139R2](#) (Address wording issues related to ISO 10646) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 8

Move to apply the changes in [P1323R2](#) (Contract postconditions and return type deduction) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 9

Move to apply the changes in [P0960R3](#) (Allow initializing aggregates from a parenthesized list of values) to the C++ working paper.

Chandler Carruth: There was a design change made based on CWG feedback. Did it get reviewed by EWG ?

Ville Voutilainen: No.

Chandler Carruth: The decision changes the consensus in EWG.

Ville Voutilainen: We didn't have time slots to look at it.

Herb Sutter: Are you as chair aware of those changes and are you comfortable that this continues to be EWG consensus.

Ville Voutilainen: I'm not sure.

Herb Sutter: Should this vote go forward ?

Ville Voutilainen: Yes.

Nico Josuttis: This is a delicate area where we rejected things in the past, and now there are design changes in CWG ?

Ville Voutilainen: The design change is not a new thing as such. There is an EWG consensus on treating the paren initialization like a constructor. That means the arguments are not evaluated in any particular order. The design change made is that they are evaluated left to right.

Herb: If you are comfortable moving it forward, say yes. If you are not, say no.

Chandler reads the summary of the paper change.

Mike Miller: Initially, the intention was that parenthesis should work just like curly braces. We found that there were problems specifying that, so the suggestion was let's make it look like a constructor call because it has parenthesis. When we tried to specify that, we ran into specification difficulties. We felt it should be like a constructor call as much as possible, but that it is still aggregate initialization, so the change was made. The major difference is in order of evaluation, and the observation in the room was that no reasonable implementation would choose anything but left to right order for evaluating the initializers. We felt it was in our purview to change the specification form, and we think the effect is the same as previously agreed upon in EWG.

Ville Voutilainen: We should keep in mind that this change allows using aggregates in library functions such as `make_shared`, `make_unique`, `allocator::construct`. Prior to this change, using aggregates with those functions was close to impossible.

Herb Sutter: It sounds to me as if the CWG chair didn't think this is something that needed to go back to EWG.

Mike Miller: That is correct.

Adam Martin: If this is not passed at this meeting, can we still get in C++20 in Cologne

Herb Sutter: Yes.

Objections to unanimous consent.

Herb reminds the group of voting rules

Hubert Tong: I may vote differently depending on whether the poll is about the paper or whether the poll is whether I'm comfortable having the design change.

Herb Sutter: the poll is about the motion on the screen.

In favor: 40
Opposed: 9
Abstain: 13

Motion passes.

Motion 10

Move to accept as a Defect Report and apply the changes in [P1009R2](#) (Array size deduction in new-expressions) to the C++ working paper. *[Note that this paper assumes that the preceding motion passes.]*

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

Motion 11

Move to apply the changes in [P1103R3](#) (Merging Modules) to the C++ working paper.

Alistair Meredith: We do not think this is ready for C++20, we think this should be aimed for C++23. we do not think this will slow down the actual implementation.

Ville: this was not conveyed to EWG.

Alistair Meredith: we believe this is a procedural discussion.

Herb Sutter: Was the paper with this information in any of the mailings ?

Steve Downey: Some of this information is in the paper on the tooling that concerns the modules, but not all of it.

John Spicer: If you have any concerns, please inform the convener and the chair groups as soon as possible so we can avoid surprises.

Pablo Halpern: There was an informal poll of the US body , and some of these objections were brought up there.

Tom Honermann: Some concerns were raised in a paper P0804 that didn't have time to be seen by EWG.

Nathan Burgers: Bloomberg did state these concerns to Barry Hedquist. During this week there were two modifications to the modules proposal, and those are the things Alisdair is referring to.

Alisdair Meredith: I mentioned this to our convener in advance of this morning's session.

Herb Sutter: Yes, you did. In our brief conversation just before we started didn't know the details of everything you planned to state. When I asked now if this was raised before this meeting, I was referring to the whole meeting, not just this plenary. Apologies for the confusion.

Nico Josuttis: We think this is a useful thing and should come. We think not having it in and just have a TS makes it difficult to happen because vendors and compilers need to do work in hope it will get accepted in the future. It can be a waste of resources so they may not go down this path. We also don't want to lose the flexibility

of finding some flaws. If we adopt it, we may not be able to fix things anymore. It may help to say this will come, but we need more time.

Herb Sutter: We want to hear concerns, but as early as possible. Can we pre-approve this for C++23 ? We tried that before, but NBs didn't like it. This is procedurally very different to what we normally do, and it creates a lot of uncertainty.

Barry Hedquist: The information that was given to me - if you are on the reflector, you saw the feedback. It also went to NB reflector, and it went to Herb Sutter.

Herb Sutter: Any discussion inside NB is for NB only. The only input to this meeting are papers.

Gabriel Dos Reis: AFAIK, the paper on the motion page does not contain design discussion we had in EWG this week.

Bryce Adelstein Lelbach: If we vote no, does that mean no to modules in C++20?

Herb Sutter: this is the last meeting for TS merges. We can do this in Cologne, but we shouldn't.

Bryce Adelstein Lelbach: If we were to do a poll in Cologne, are we going to see substantial design changes?

Ville Voutilainen: As far as being able to make fixes and changes, we have a year and three meetings during that time.

J. Daniel Garcia: If we find some issues, we still have time to issue NB comments to the draft and the CD. We should merge and solve any issues as they arise

Nico Josuttis: I think it's not acceptable to make this move in Cologne. It is a big feature, and it will take a long time in CWG and LWG.

Corentin Jabot: We have been designing modules to get them in C++20, but not to get them right, and I have concerns about this.

Daveed Vandevoorde: Does evolution convene in Cologne ?

Ville Voutilainen: Yes.

Isabella Muerte: I would like to see this, I don't think we will make any changes soon. Most of the issues I have is how it's being implemented, but that can be hashed out within implementers themselves

Davis Herring: Single file module approach chosen by EWG this week was adopted by core as presented. Internal linkage was not adopted because it has implementation undesirability and can be fixed later.

Objections in the room.

In favor: 43

Opposed: 6

Abstain: 16

Motion passes.

Herb Sutter: thank you to everyone who has contributed.

Peter Bindels: is this going to be recorded somewhere ?

Herb Sutter: the vote counts will be in the published minutes.

Motion 12

Move to apply the changes in [P1185R2](#) ($\Leftarrow \Rightarrow$ \neq \Rightarrow) to the C++ working paper.

Mathias Stearn: There is an issue with this paper. If you define an ordering using the spaceship operator and default the equality operator, you still get member wise equality resulting in an inconsistent ordering.

Ville Voutilainen: This was not discussed in EWG. I do not have a concern about this motion. We can address any issues at future meetings. We can fix the issues even after we publish the standard. We do that all the time.

Herb Sutter: Yes, we always have unknown bugs, the question is if an issue is a show stopper or not.

No objection to unanimous consent.

Motion passes.

Walter Brown: Because of the work Herb did in front loading the spaceship operator, making a concurrent presentation in evolution and library evolution, and incorporating both in the initial design paper I believe the spaceship operator is going to among the best integrated new features. I would like to thank Herb and hope we will all consider the same model in the future.

Reflection TS

Motion 13

Move to apply the changes in [P1390R1](#) (Reflection TS NB comment resolutions: summary and rationale) to the Reflection TS working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 14

Move to appoint a review committee composed of Axel Naumann, Roger Orr, Hubert Tong, and Guy Davidson to approve the correctness of the Technical Specification for C++ Extensions for Reflection working paper as modified by the motions approved at this meeting, and to direct the Convener to transmit the approved updated working paper for publication.

Mike Miller: We need volunteers for the review committee.

Roger Orr, Hubert Tong, Guy Davidson volunteer.

Jens Maurer updates the motion with the names of the reviewers.

Hubert Tong: is the committee aware of the large editorial change ?

Herb Sutter: I announced it on the reflector. TS had to be rebased on the Concepts TS. This is an editorial change, not a functional change.

Alisdair Meredith: Does that mean it is based on C++14 because Concepts TS is based on C++14?

John Spicer: Yes.

No objection to unanimous consent.

Motion passes.

Coroutines

Motion 15

Move to apply the changes in [P0912R5](#) (Merge Coroutines TS into C++20 working draft) to the C++ working paper and incorporate all open issues against the TS into the core language issues list.

No discussion.

Objections in the room:

In favor: 48

Opposed: 4

Abstained: 15

Motion passes.

Ryan McDougall: Thank you to competing proposals.

There was extended applause for all of the coroutines proposals' authors.

John Spicer/Herb Sutter: Thank you to everyone for coming together to find a solution that reaches a consensus on what is a difficult technical problem.

- **Library (Clow)**

Marshall Clow presents. LWG started the week with 56 papers on our plate, of which I scheduled 40. The others were either not ready or were targeting one of the TS's. We saw 33 and will see more this afternoon. We are moving 17 today. LWG did issues processing on Wednesday night. We have more papers that came in than what we resolved. We are planning to have several telecons before Cologne to go through the list of papers scheduled for C++20. I will send an announcement of these on the admin and library reflector. Please contribute.

Titus Winters: There is no guarantee that everything LEWG moved will go through LWG in time to make C++20. A request to LWG - please let us have an estimate of how much bandwidth you will have and LEWG will prioritize the papers we forward to you.

Marshall Clow: Sure.

Marshall Clow continues. We have more work on our plate for C++20 than we can finish in time, unless we do more work between now and Cologne.

We are not motioning the following papers because they are large and we didn't finish the review:

- P0201 - A polymorphic value-type for C++
- P0429 - A Standard flatmap
- P1222 - A Standard flat-set
- P1135 - The C++20 Synchronization Library
- P0792 - `function_ref`: a non-owning reference to a Callable

We will look at these again. LWG pulled motion 5 off the table because I found out CWG needs to look at it first.

Herb Sutter: Thank you to LWG and CWG for doing all the hard work of reviewing the wording.

LWG Motions

Library Fundamentals

Motion 1

Move to apply the changes in [P0052R10](#) (Generic Scope Guard and RAII Wrapper for the Standard Library) to the Library Fundamentals 3 working paper.

Marshall Clow: The wording is based on the C++ working paper, but we want to apply it to the Library Fundamentals 3. We can approve it as is and apply most of it to the LF3. We would then bring another paper with extra wording needed to apply it to LF3. Otherwise, we can not approve it and make an LF3 specific paper.

Herb Sutter: What is a level of change needed to apply it to LF3 ?

Marshall Clow: There would need to be some wording added to LF3 to accommodate this because it relaxes the requirements. This is because one of the scope guards has a throwing destructor. Otherwise, it is just a library addition.

No objection to unanimous consent.

Motion passes.

Thomas Köppe: This may not be ready to be included in the post-meeting mailing.

Draft Standard

Motion 2

Move to apply to the C++ working paper the proposed resolutions of all of the issues in [P1457R0](#) (C++ Standard Library Issues to be moved in Kona).

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 3

Move to apply the changes in [P0339R6](#) (`polymorphic_allocator<>` as a vocabulary type) to the C++ working paper.

No discussion.

Objections in the room:

In favor: 40

Opposed: 0

Abstained: 24

Motion passes.

Motion 4

Move to apply the changes in [P0340R3](#) (Making `std::underlying_type` SFINAE-friendly) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

~~*Motion 5*~~

~~Move to apply the changes in [P1272R1](#) (Byteswapping for fun&&nuf) to the C++ working paper.~~

Motion 6

Move to apply the changes in [P0738R2](#) (I Stream, You Stream, We All Stream for `istream_iterator`) to the C++ working paper.

Herb Sutter: Please put amusing things in the body of the paper. A meaningful paper title makes it easier to find.

No objection to unanimous consent.

Motion passes.

Motion 7

Move to apply the changes in [P1458R1](#) (Mandating the Standard Library: Clause 16 - Language support library) to the C++ working paper.

Marshall Clow: over the last few meetings, LWG has been discussing changes to the ways we specify the rules in the WP. The next few papers go through the clauses of the library and apply the new guidelines. These are mostly mechanical changes. There will be more of these in Cologne.

No objection to unanimous consent.

Motion passes.

Motion 8

Move to apply the changes in [P1459R1](#) (Mandating the Standard Library: Clause 18 - Diagnostics library) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 9

Move to apply the changes in [P1462R1](#) (Mandating the Standard Library: Clause 20 - Strings library) to the C++ working paper.

Marshall Clow: There is no paper for Clause 17 because there are no changes need for it. There is no motion for Clause 19 because it's huge and the changes haven't been done yet.

No objection to unanimous consent.
Motion passes.

Motion 10

Move to apply the changes in [P1463R1](#) (Mandating the Standard Library: Clause 21 - Containers library) to the C++ working paper.

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

Motion 11

Move to apply the changes in [P1464R1](#) (Mandating the Standard Library: Clause 22 - Iterators library) to the C++ working paper.

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

Motion 12

Move to accept as a Defect Report and apply the changes in [P1164R1](#) (Make create_directory() Intuitive) to the C++ working paper.

Davis Harring: This takes a test that user need to make and does it for them. It may be what they want but it is an extra system call.

Objections in the room.
In favor: 48
Opposed: 1
Abstained: 13
Motion passes.

Motion 13

Move to apply the changes in [P0811R3](#) (Well-behaved interpolation for numbers and pointers) to the C++ working paper.

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

Motion 14

Move to apply the changes in [P1001R2](#) (Target Vectorization Policies from Parallelism V2 TS to C++20) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 15

Move to apply the changes in [P1227R2](#) (Signed ssize() functions, unsigned size() functions) to the C++ working paper.

Ville Voutilainen: Can you give us an outline ?

Marshall summarizes the change. The paper affects span even though the title doesn't say so.

Objections in the room.

In favor: 42

Opposed: 5

Abstained: 19

Motion passes.

Motion 16

Move to apply the changes in [P1252R2](#) (Ranges Design Cleanup) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 17

Move to apply the changes in [P1024R3](#) (Usability Enhancements for `std::span`) to the C++ working paper.

Peter Sommerlad: This depends on the changes we just applied with span.

Marshall: I have volunteered to help the editors make the changes.

Cristian Trott: We are concerned regarding deprecating the comma operator in span. We think this will be problematic for adoption of generic programming.

Alisdair Meredith: That deprecation will not solve the problem.

Isabella Muerte: The operator comma deprecation paper is still in the pipeline.

No objection to unanimous consent.

Motion passes.

Motion 18

Move to apply the changes in [P0920R2](#) (Precalculated hash values in lookup) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Motion 19

Move to apply the changes in [P1357R1](#) (Traits for [Un]bounded Arrays) to the C++ working paper.

No discussion.

No objection to unanimous consent.

Motion passes.

Marshall Clow: Thank you to all the scribes.

Pablo Halpern: During EWG report it was mentioned that a poll has been taken on changing the name . How does that change progress from here ?

Ville Voutilainen: Proposal author will create a wording. CWG will review the wording, and it will come here as a motion.

- Direction Group (Hinnant)

Howard Hinnant presents. Direction met this week for an hour. There is nothing to report from that meeting. We have regular meeting every two weeks, and we'll be meeting in two weeks time. If you have any question, please contact me or anyone else from the Direction Group. I would like to remind everyone of our standing paper P939, which is updated several times a year.

8. Closing activities

8.1 Issues delayed until today

No discussion.

8.2. PL22.16 motions, if any

- 1) **PL22.16, the US TAG to ISI/IEC JTC1 / SC22 / WG21, approves to WITHDRAW ISO/IEC TS 19571:2015 in the Systematic Review for that document.**

Barry Hedquist moves.
Adam Martin seconds.

Barry Hedquist clarifies the voting rules. You can vote if you are a PL22.16 representative for your company. One vote per company.

Hubert Tong: The TS is not just for the committee. It might have served its purpose for the committee, but it hasn't necessarily finished its useful lifetime in terms of its users. When we go end of life on a TS, it means we pull maintenance from people who might need clarification of the specification in an official form.

In favor: 36
Opposed: 0
Abstained: 2
Motion Passes

9. Plans for the future (PL22.16)

9.1 Next and following meetings

2019-07-15/20: Cologne, Germany ([N4783](#))

Nico Josuttis presents. No main sponsors, two individual sponsors (Volker Dorr and Mike Spertus). Thank you. Nico presents the location, details in N4783. There was an update of the link to register. GDPR note: hotel is allowed to send me the emails of people who registered. An event is happening in Cologne at the same time, hotels will be filling up. Register before deadline on May10,2019.

If you can, book flights to QKL which includes a train ride to Cologne.

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

Roger Orr presents. Jamie Allsop will be hosting the meetings. We are looking for sponsors. There will be a mini ACCU conference at the end of the meeting. I'm hoping committee members will be interested in talking or attending. Please let me know. The booking should open next month and you can book for both at the same time.

2020-02-10/15: Prague, Czech Republic

Hana Dushikova presents.

2020-06-01/06: Bulgaria

No exact details yet.

2020-11: New York, tentative

2021-02: Kona, HI, USA

Peter Sommerlad: Can we avoid holidays when we plan meetings ?

Herb Sutter: It is very difficult to do that. We try to avoid major holidays.

Nico Josuttis: This is a lovely place to be, but a difficult place to get to.

Herb Sutter: We appreciate that, but this is a cheap location to organize a meeting.

Peter Sommerlad: Can hosts please advise if there are public holidays during the committee meeting so we can make adjustments.

9.2. Mailings

2018-03-11: Post-Kona

2019-06-17: Pre-Cologne

Hal Finkel: thank you for trying out automated paper handling system. We believe it's working now. If you have a problem, please e-mail me. The old Google form is still active, and will be active until the numbers would collide, but please use the new system. You can upload any file you want to get a number, and then replace it with the real paper.

I will be sending out a note on specific details.

Herb Sutter: Thank you to Hal.

Jens Maurer: Looking for volunteers who are taking the projectors to Cologne. Please send me an e-mail if you are a volunteer.

Ville Voutilainen: EWG will meet at 1 pm.

Mike Miller: CWG will meet after lunch for issues processing.

Marshall Clow: LWG will meet this afternoon.

Titus Winters: LEWG will not be meeting this afternoon.

10. Adjournment

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. Adam Martin seconds.
Approved by unanimous consent.

John Spicer adjourns the meeting at 11:26 am UTC-10.

11. Attendance

Name	Representing	NB
Aaron Ballman	GrammaTech Inc	
ADAM David Alan Martin	MongoDB Inc	
Alan Talbot	LTK Engineering Services	
Alex Wells	Intel Corporation	
Alisdair Meredith	Bloomberg	
Andreas Weis	BMW	
Andrew Lumsdaine	Pacific Northwest National Laboratory	
Andrzej Krzemienski		PL
Anton Polukhin	Yandex.Taxi	RU
Attila Feher	Bloomberg	
Authur O'Dwyer		
Axel Naumann	CERN	CH
Barry Hedquist	Perennial	
Barry Revzin	Jump Trading	
Ben Boeckel	Kitware, Inc.	
Benjamin Craig	National Instruments	
Benjamin Saks	Saks & Associates	
Billy Baker	FlightSafety International	

Name	Representing	NB
Bjarne Stroustrup	Morgan Stanley	
Botond Ballo	Mozilla	CA
Brian Van Straalen	Lawrence Berkeley National Laboratory	
Bruno Lopes	Apple	
Bryce Adelstein Leibach	NVIDIA Corporation	
Casey Carter	Microsoft Corporation	
Chandler Carruth	Google	
Chanyoung Park		CA
Charles-Henri Gros	Synopsys Inc	
Chris Kennelly	Google	
Chris Kohlhoff		GB
Christian Trott	Sandia National Laboratories	
Christof Meerwald	Programming Research Ltd	
Christopher Di Bella	Codeplay	
Christopher Earl	Lawrence Livermore National Laboratory	
CJ Johnson	Google	
Corentin Jabot		FR
Damien Lebrun-Grandie	Oak Ridge National Laboratory	
Daniel Sunderland	Sandia National Laboratories	
Danila Kutenin	Yandex	
Daveed Vandevoorde	Edison Design Group	
David Goldblatt	Facebook	
David Hollman	Sandia National Laboratories	
David Olsen	NVIDIA Corporation	
David Sankel	Bloomberg	

Name	Representing	NB
David Stone	Google	
Davis Herring	Los Alamos National Laboratory	
Dawn Perchik		
Detlef Vollmann	Vollmann Engineering	CH
Dietmar Kühl	Bloomberg	
Ellen Hedrick	Edison Design Group	
Eric Fiselier	Google	
Eric Niebler	Facebook	
Erich Keane	Intel Corporation	
Fabio Fracassi		DE
Faisal Vali		
Frank Birbacher	Bloomberg	
Gabriel Dos Reis	Microsoft Corporation	
Geoffrey Romer	Google	
Georgi Dimitrov	VMware Inc	BG
Gor Nishanov	Microsoft Corporation	
Graham Lopez	Oak Ridge National Laboratory	
Guy Davidson	Creative Assembly	GB
Guy Somberg	Echtra Games	
Hal Finkel	Argonne National Laboratory	
Hana Dusíková	AVAST	CZ
Hans Boehm	Google	
Herb Sutter	Microsoft Corporation	
Howard Hinnant	Ripple Labs	
Hubert Tong	IBM Corporation	CA

Name	Representing	NB
Iain Sandoe		
Isabella Muerte		
J. Daniel García	University Carlos III of Madrid	ES
J.C. van Winkel		NL
Jade Alglave	ARM Ltd	
James Dennett	Google	
James Touton	Blizzard	
Jared Hoberock	NVidia Corporation	
Jason Carey	MongoDB Inc	
Jason Merrill	Red Hat Inc	
Jean-Francois Bastien	Apple	CA
JeanHeyd Meneide		
Jeff Garland	Crystal Clear Software	
Jeff Snyder	PDT Partners	GB
Jeffrey Mendelsohn	Bloomberg	
Jeffrey Yasskin	Google	
Jens Maurer	Edison Design Group	
John Lakos	Bloomberg	
John Spicer	Edison Design Group	
Jonathan Brian Coe		GB
Jonathan Caves	Microsoft Corporation	
Jonathan Wakely	Red Hat Inc	GB
Jorg Brown	Google	
Joshua Berne	Bloomberg	
Juan Alday	GreenWireSoft	

Name	Representing	NB
Kelly Walker	Stellar Science	
Kirk Shoop	Facebook	
Lars Gullik Bjønnes	Cisco Systems Inc	
Lawrence Crowl	Perennial	
Lee Howes	Facebook	
Lewis Baker	Facebook	
Li-Ta Lo	Los Alamos National Laboratory	
Lisa Lippincott	Tanium	
Louis Dionne	Apple	CA
Maged Michael	Facebook	
Marcin Grzebieluch	Sii Poland	PL
Mark Hoemmen	Sandia National Laboratories	
Marshall Clow	C Plus Plus Alliance Inc	
Mateusz Pusz	EPAM Systems Inc	PL
Mathias Stearn	MongoDB Inc	
Matt Calabrese	Google	
Maurice Barnhy		
Michael Garland	NVidia Corporation	
Michael Spencer	Apple	
Michael Spertus	Symantec	
Michael Wong	Codeplay	CA
Michał Dominiak	NVidia Corporation	PL
Mihail Mihaylov		BG
Mike Herrick	Edison Design Group	
Nathan Burgers	Bloomberg	

Name	Representing	NB
Nathan Myers	Maystreet	
Nathan Sidwell	Facebook	
Nathaniel Goodspeed	Linden Research, Inc	
Neal Meyer	Amazon Corporate LLC	
Nevin Liber	Argonne National Laboratory	
Nicolai Josuttis		DE
Nicolas Lesser	Albert-Ludwigs-Universität Freiburg	
Nina Dinka Ranns	Edison Design Group	GB
Olga Arkhipova	Microsoft Corporation	
P.J. Plauger	Dinkumware Ltd	
Pablo Halpern	Intel Corporation	
Patrice Roy	Université de Sherbrooke	CA
Paul McKenney	IBM Corporation	
Paul Preney	University of Windsor	CA
Peter Sommerlad	HSR	CH
Rene Rivera	C Plus Plus Alliance Inc	
Richard Smith	Google	
Robert Schumacher	Microsoft Corporation	
Robert Simpson	Qualcomm Inc	
Robert Steagall	KEWB Computing	
Roger Orr		GB
Ronan Keryell	Xilinx	
Rostislav Khlebnikov	Bloomberg	
Ryan McDougall	Zoox Inc	CA
Sebastian Messmer	Facebook	

Name	Representing	NB
Shuo Feng Liu	IBM Corporation	CA
Stephan Boekelmann	Ruhr-Universität Bochum	
Stephen Michels	WGZM	
Stephen Schurr	Ripple Labs	
Steve Downey	Bloomberg	
Sylvio Dos Reis		
Tabea Röthemeyer	Ruhr-Universität Bochum	
Tana Plauger	Dinkumware Ltd	
Thomas Koeppe		
Thomas Plum	Plum Hall Inc	
Thomas Rodgers	Red Hat Inc	
Thomas Scogland	Lawrence Livermore National Laboratory	
Tim Northover	Apple	
Timur Doumler	Jetbrains	GB
Titus Winters	Google	
Tom Honermann	Synopsys Inc	
Tyler Sutton	Lock3Software	
Victor Zverovich	Facebook	
Ville Voutilainen	Plum Hall Inc	FI
Vincent Reverdy	Paris Observatory	FR
Vito Giovanni Castellana	Pacific Northwest National Laboratory	
Walter Brown	Brown	
William Miller	Edison Design Group	
William Seymour	Seymour	
Wyatt Childers	Lock3Software	

Name	Representing	NB
Xinmin Tian	Intel Corporation	
Zach Laine	Cadence	