

Virtual Conferences

A Guide to Best Practices

A community resource from the
ACM Presidential Task Force on
What Conferences Can Do to Replace Face-to-Face Meetings

Version 1.2 -- May 24, 2020

Abstract

“Our conference organizing committee just decided to switch our physical conference to online. But the conference is supposed to start in three weeks, and none of us have ever even been to a virtual conference, much less put one on! Where do we start???”

This document is a practical introduction to the brave new world of virtual conferences, assembled and curated by members of the Association for Computing Machinery’s Presidential Task Force on What Conferences Can Do to Replace Face-to-Face Meetings.

With so many conferences going online in a short time, there are many organizers with urgent questions; at the same time, new insights, ideas, and experiences are being generated at a furious rate. We hope that this Guide will serve both as a basic orientation for newcomers and as a repository of accumulated knowledge from the community.

As heavy users of online technologies and as researchers responsible for developing them, the ACM community is especially well-positioned to offer advice that we hope will be helpful to other groups dealing with the same problems.

How to read this Guide: This document is intended to serve as a comprehensive resource for understanding, organizing, and running virtual conferences.

- The [Introduction](#) sets the stage and identifies the context of this Guide.
- [High-Level Planning](#) describes a range of issues to be considered when planning a virtual conference, based on prior experiences with these events.

- [Technology](#) offers some concrete advice on hardware, internet connectivity, audio/visual support, and specific communication platforms; it includes a large [table](#) comparing available platforms.
- [Nuts and Bolts](#) discusses specific issues related to the different parts of a conference (plenary and paper sessions, workshops, etc.) and offers concrete “bootstrap suggestions” for how to put on conferences of various sizes.
- [Fostering Social Interactions](#) discusses what virtual conferences can do to replace the informal, unstructured interactions that are the lifeblood of physical conferences.
- [Other Resources](#) is a list of links to interesting documents related to moving events online.
- The [Appendices](#) (available only in the [live version](#) of the guide) include an extensive and evolving collection of links to experience reports, as well as additional ideas that organizers may want to experiment with.

If you want a quick start, jump straight to the [Bootstrap Suggestions](#) before exploring the rest of the document.

How to contribute: Since it surveys a rapidly evolving topic, this guide is based on a [live Google document](#) that is periodically versioned. We welcome contributions from readers!

- Organizers of past virtual conferences: please add links to your reports in the [Appendices](#) section of the live document.
- Organizers of upcoming virtual conferences: if you have questions that are not covered in this document, you are welcome to leave comments in the [live one](#).
- Experts in any relevant area: please give us your thoughts in the form of comments or edits in the [live document](#).
- Additionally, the whole task force can be reached at virtual-conferences@acm.org.

This report was created by the Association for Computing Machinery, Inc. and we are placing it in the Public Domain. Contributions are gratefully accepted with the understanding that any contributions are also placed in the public domain.

How to cite this document: We suggest that citations to any part of this Guide, including the companion table and appendices, read as follows:

[ACM PTF RF2F 2020] ACM Presidential Task Force on What Conferences Can Do to Replace Face to Face Meetings, “Virtual Conferences, A Guide to Best Practices”, 2020; <https://www.acm.org/virtual-conferences>

Organization of the Task Force

- Founding Documents: the original [Proposal](#) for the task force and its official [Charter](#) from the ACM.
- Members:
 - [Crista Videira Lopes](#), University of California, Irvine, USA (Task Force Co-chair, former Treasurer of SIGPLAN, member of SIGPLAN ad-hoc [committee on climate change](#))

[Jeanna Matthews](#), Clarkson University, USA (Task Force Co-chair, member of ACM Council, Former SGB Chair)

[Benjamin C. Pierce](#), University of Pennsylvania, USA (Task Force Executive Editor, SIGPLAN Vice Chair, chair of SIGPLAN ad hoc [committee on climate change](#))

[Blair MacIntyre](#), Georgia Tech, USA (Chaired IEEE VR 2020)

[Gary Olson](#), University of California, Irvine, USA (Former SIGCHI Treasurer; Chair of CSCW Steering Committee, chaired CHI, CSCW, DIS, and many non-ACM conferences)

[Rob Lindeman](#), University of Canterbury, NZ (Chaired IEEE VR 2010)

[Francois Guimbretiere](#), Cornell University, USA (Chaired UIST 2019)

[Srinivasan Keshav](#), University of Cambridge, UK (Former SIGCOMM Chair)

- Ex-officio members:

[Vicki Hanson](#) (ACM CEO, Former ACM President)

Pat Ryan (ACM COO)

Donna Cappelletti (ACM Director of SIG Services)

Contributors (in alphabetical order):

[Jeremy Baumberg](#), [Susanne Boll](#), [Donna Cappelletti](#), [Francois Guimbretiere](#), [Vicki Hanson](#), [Alan Jeffrey](#), [Srinivasan Keshav](#), [Konrad Kording](#), [Clifford Lampe](#), [Rob Lindeman](#), [Crista Videira Lopes](#), [Blair MacIntyre](#), [Jeanna Matthews](#), [Gary Olson](#), [Judith Olson](#), [Jens Palsberg](#), [Benjamin C. Pierce](#), [Anthony Robins](#), [Pat Ryan](#), [Henning Schulzrinne](#), [David A. Shamma](#), [Alan Smeaton](#), [Anthony Steed](#), [John Tang](#), [Austin Tate](#), [Shari Trewin](#), [Dave Thomas](#)

Table of Contents

1 Introduction	5
2 High-Level Planning	6
2.1 Organizing Committee	7
2.2 Planning for Virtual Presence	8
2.3 Navigation	9
2.4 Dealing with Time Zones	10
2.5 Carving out Mental Space	11
2.6 Registration	12
2.7 Finances	13
2.8 Preparing to Deal With Disruption	14
2.9 Fairness and Inclusiveness	15
2.10 Accessibility	15
3 Technology	17
3.1 Conference Hosting	17
3.1.1 Specific Platforms and Tools	17
3.1.2 “On-Site” A/V and IT Support	18
3.2 Requirements for Participants	19
3.2.1 Hardware	19
3.2.2 Internet Connectivity	20
3.3 Security and Privacy Issues	20
4 Nuts and Bolts	22
4.1 Supporting the Parts of a Conference	22
4.1.1 Program Committee Meeting	22
4.1.2 Plenary Sessions	22
4.1.3 Paper Sessions	23
4.1.4 Workshops, Doctoral Consortia, and Tutorial Sessions	23
4.1.5 Poster, Exhibitor, Birds of a Feather, and Demo Sessions	23
4.1.6 Speaker Preparation	24
4.1.7 Archival storage	25
4.2 Bootstrap Suggestions	25
4.2.1 Going Virtual with Low Overhead	26
4.2.2 Small Conference or Large Workshop	26
4.2.3 Medium-Sized Conference	28
4.2.4 Large Conference	29
5 Fostering Social Interactions	29
6 Other Resources	32

7 Appendices	34
7.1 Context of This Guide	34
7.2 Examples of Virtual Conferences	36
7.3 Experience reports	37
7.3.1 ICLR 2020	37
7.3.2 EDBT/ICDT 2020	37
7.3.3 ASPLOS 2020 virtual conference	37
7.3.4 ACMSE 2020 Conference	37
7.3.5 Ubuntu Developers' Conference, 2020	37
7.3.6 American Academy of Religion, Western Region (AARWR) Virtual Conference	37
7.3.7 CHI 2019 virtual PC meeting	37
7.4 Security and Privacy Issues In Zoom (Early 2020)	37
7.5 Hybridizing Physical and Virtual Conferences	38
7.6 Virtual Conference Finances	39
7.7 Virtual Conference Sponsorship	41
7.8 Ideas for Research and Experimentation	42

1 Introduction

The spread of COVID-19 is causing disruption world-wide, forcing conference cancellations, and leaving organizers scrambling for alternative ways of disseminating the work that was to be presented. In response, the Association for Computing Machinery (ACM) has convened a Presidential Task Force (PTF) to rapidly gather and disseminate best practices and immediately implementable options.

This Guide is meant to shed light on the territory of online conferencing for those considering offering some form of online participation for conferences that are being cancelled.¹ Fortunately, online conferences have been happening for a long time, mostly in niche communities outside the ACM. The guidelines presented here are mainly derived from knowledge acquired from those communities. However, since mid-March 2020, a few ACM conferences have rapidly adopted some form of online participation. As those events happen, we are asking the organizers to write up experience reports, which we will continually add to this document. Accordingly, we expect the document to evolve as we learn more about what works.

¹ We focus mostly on fully online conferences, since these are what people are trying to figure out right now. Some hints and pointers on physical/virtual hybrids can be found in [this appendix](#).

The easiest option for conference organizers is to forego a synchronous meeting altogether and focus only on its asynchronous “outputs”— published papers, pre-recorded videos, published software artifacts, and maybe even asynchronous Q&A. (A good example of this model is explained [here](#).) This is a straightforward fallback option for conferences that cannot take place physically. Unfortunately, this model eliminates what makes a conference a conference: the real-time social interaction among participants. Eliminating this component, or replacing it with interactions with long temporal intervals (e.g., text-based discussion forums), essentially amounts to falling back to a publication-only model. Moreover, preliminary evidence from [ASPLOS 2020](#) shows that participants in conferences organized this way may really miss synchronous interaction.

Therefore, we are writing here primarily for organizers of academic conferences who want to create online spaces for real social interaction and networking and thus maintain at least some of the benefits of synchrony from their formerly physical conferences. We should emphasize, though, that although we use the word “virtual” throughout this Guide as a synonym for “online,” we are *not* recommending that all conferences attempt to reconstitute themselves in full-blown virtual reality, complete with 3D scenery, virtual exhibit halls, avatars, and all the rest. There have been some heroic experiments in this direction (e.g., the recent [IEEE VR](#) conference, and the long-running [Open Simulator](#) conference), but the technological demands on both organizers and participants are not for the faint of heart.

The sudden need to move *all* conferences online is, of course, an unexpected development, but there had already, for many years, been a growing interest in ways to support remote participation in physical conferences, as well as ways to organize fully online and mixed events. This increasing interest has been motivated by community awareness of [environmental sustainability](#) and [climate change](#), [diversity](#), [inclusion](#), and [economic justice](#). For these reasons, the ACM has convened a Task Force on Virtual Conference Experience (completely separate from the present task force) for analyzing more strategically the tradeoffs and broader impacts of virtual conferences on the ACM community. Accordingly, this Guide avoids these longer term issues, and focuses entirely on the pragmatics of organizing virtual conferences right now, offering immediately implementable options and experience-based best practices for organizers who have already decided that they want to take their conferences online.

2 High-Level Planning

One of the most fundamental takeaways from past experiences with virtual conferences is that the important challenges are not only about the technology that supports them, but are, first and foremost, about *rethinking* and *retargeting* the things that organizers and participants normally do into new media and new forms of interaction. Virtual conferences need just as much people power and organizational logistics as physical conferences. The roles within organizing committees are pretty much the same, but some of these roles will see their activities radically shifted from dealing with physical matters to dealing with online matters; the planning topics and

activities are also pretty much the same, but again shaped by the new media. This section outlines these important shifts.

Here and throughout this Guide, we concentrate on the organization of the conference itself. Some advice on virtual program committee meetings can be found [below](#).

2.1 Organizing Committee

Virtual conferences are *conferences*. That is, they present a live, real-time program enacted and observed by people, and they foster real-time technical and social interaction among participants. A corollary that may take organizers by surprise is that virtual conferences require as much planning and behind-the-scenes real-time logistics as physical conferences; it is a mistake to assume that a virtual conference will “just happen” if the organizers choose some real-time interaction platform and tell people when and where to show up.

Virtual conferences require organizing committees quite similar to those of physical conferences, including the need for volunteers during the conference, but with some significant rethinking required for each of the roles:

- **“Local” Arrangements:** The “venue” of a virtual conference is a platform, or a set of platforms, where social interaction will take place. Accordingly, the “local arrangements” team will now need to include people with specialized technical skills, including audio-visual and streaming expertise, who will be able to choose and manage the platform(s) where interactions will take place. The local arrangements team will also serve as, or interact with, the hosts of conference sessions.
- **Hosts** are responsible for starting and managing the live sessions. Although they are the owners of the sessions, they are typically invisible except to those participating in those sessions during the “green room” period of the sessions (a period before the sessions start). They are the ones saying “3, 2, 1... live” and are the ones with super-powers. Hosts may be volunteers who are part of the local arrangements team or they may be contracted professionals. More on this in the section on [On-Site A/V support](#).
- **Session Chairs:** These are the moderators who make sessions of the conference work. Although they can be drawn from the same set of people who would serve as session chairs in physical conferences (e.g., Program Committee members), they require additional advice and training to make sessions successful. Their sessions may also be quite different from the ones we are used to in academic physical conferences, as they may involve bringing in pre-recorded videos and groups of speakers, instead of traditional talks.
 - Session chairs need to join sessions at least 15 minutes before they start, make sure all presenters are there and find them quickly if they aren’t, introduce the session properly (“This is session so and so of conference X”), gather questions from the audience in chat channels, manage the flow of events, and keep track of time. In cases when live presenters go unreasonably longer than their allotted

time, session chairs can (and sometimes must) intervene, including by muting the speakers, as there may be strict time limits for the use of the platform or related to time zones.

- In very small events, the roles of session chair and host may be played by the same person, but for conferences even as large as 100 participants, this is not a good idea, as those roles require completely different skills.
- **Volunteers:** A virtual conference needs at least as many volunteers as a physical conference. Volunteers need to be present in each virtual meeting space, monitor the chat channels, greet participants, staff reception areas, help users test their audio, help train session chairs and speakers, help session chairs gather questions, and interface with the rest of the organizing team when problems arise. They should be easily identifiable through visual cues, naming conventions, etc. Roughly, there should be one volunteer per meeting room or chat channel, plus a few in a “landing” or reception space for newcomers, if the setup includes such a thing. Just as in a physical conference, volunteers need to be trained in advance and someone needs to oversee their activities during the conference.
- **Entertainment and Social Interaction:** Some physical conferences include in their organizing committees a group of volunteers whose task is to set up an entertainment program that may include live music, outings, etc. This task is even more important in virtual conferences. Someone in the organization should be in charge of adding things for participants to do online together. See [Fostering Social Interactions](#) below.

Given that virtual conferences use online platforms, which will be new for most participants, organizers cannot rely on speakers’ prior experiences giving conference talks. It is strongly advised that organizers set up training sessions ahead of time for speakers and session chairs, so that they can learn how to function in the platform(s) where the conference is taking place and how to interact with people in other roles and with the audience. These training sessions can be as short as 15 minutes. Training speakers and session chairs is a task that can engage many student volunteers.

Another issue that organizers should keep in mind is that virtual conferences are even less forgiving than physical ones if something is not working as planned, such as a microphone not working, audio feedback, or the location of a workshop changing. Testing and rehearsing ahead of time mitigates these problems.

2.2 Planning for Virtual Presence

In physical conferences, ‘presence’ means physical presence. In virtual conferences, the participants’ presence is virtualized through media including video, audio, graphics, and text.

One might think that the way to organize a virtual conference would be as one big shared space, where everyone shares multiple media streams with everyone else. However, this

approach is both technically challenging and not necessary for a successful meeting. *Different parts of a virtual conference require different media for different groups of participants.*

For example, in plenary sessions -- where everyone comes together -- there is a natural separation between those on stage (one or just a few people) and those in the audience (possibly a very large group). Those on stage can be part of a smaller, media-rich shared space that is then livecast to the larger audience -- or even publicly onto the Web. Livecasting is cheap and efficient, and there are plenty of options to choose from.

Nevertheless, it is much more engaging when the audience itself also has a live presence for each other and for the speakers on stage: the speakers feel like they have an audience, and the people in the audience feel that they are in a group, not watching TV alone. Currently, one of the most effective ways to host very large groups of people in a shared space is using text messaging. Therefore, independent of what media is chosen for rendering the people on stage, the glue that binds participants together is text chat. This makes all the difference between a person watching a video of a talk by themselves, and watching a talk together, at the same time, with a group of like-minded people. There will need to be several group-chat channels, including some for all simultaneous participants in the conference, some session-related channels, and smaller, more specialized chat channels for smaller groups. It is important that the text chat feeds are monitored by an identified person, that questions are fed into the live session as appropriate, and that feedback is given to the speakers during live sessions, as they may not be able to monitor the relevant feeds themselves while giving their talks.

There is a tension for organizers between providing too many channels (hard to watch them all, hard to get conversation going) and too few, unfocused channels. Besides a few public channels (e.g., help and general) and a few private role-based channels (e.g., organizers, presenters, student volunteers), a good rule of thumb is to think of chat channels for the participants as individual rooms in a physical conference venue. You can even call them "Room A", "Room B", etc. Rather than having one channel per session, which will quickly become confusing, consider having one channel per sequence of sessions; the temporal distribution of the presentations will be reflected in the chat on those channels.

Session chairs/channel facilitators are tasked with asking targeted questions to presenters that get the conversation started. As with any social gathering, it takes organization and effort to avoid "dead air" and stimulate interaction and conversation.

The choice of [Platform](#) should be made with the goal of reaching a good balance between participants' sense of presence, scalability, geographic reach, and simplicity. The number of expected participants has a tremendous impact on this balance.

2.3 Navigation

In physical conferences, navigation is naturally supported by the layout of the conference venue. However, even in those conferences, organizers need to do much more than letting people roam around. At a minimum, a printed or online program with the schedule plus information about each session, including room numbers, the floorplan of the venue, etc., is a requirement for participants to be able to find the sessions and the people they are interested in.

In virtual conferences, navigation is equally important. The live sessions of virtual conferences need to be easy to find and get into. The online program needs to have information about when and “where” the sessions will take place, e.g., the Zoom meeting links, the Webinar links, the Slack channels, etc. All of this information should be presented through user interfaces that are easy to understand and with links that “teleport” participants to the “places” they want to go. For specific suggestions, see “Navigation” under [Ideas for Research and Experimentation](#).

2.4 Dealing with Time Zones

When participants are within a limited range of time zones (e.g., mostly US, mostly Europe, mostly Asia, or US + Europe), it may be possible to schedule sessions at reasonably convenient times for everyone. However, when participants live around the world, time zones are likely to become one of the biggest challenges for a virtual conference.

There are no great solutions to overcome the fact that some people will be sleepy when others are wide awake. There are, however, a number of workable approaches:

- Plenary sessions can be short (e.g., 2 hours) and happen at a time when 2/3 of the world is awake at the same time. These 2-hour sessions can be staggered over each 24-hour cycle. Their times can be: 12-2am UTC (Asia-America), 7-9am UTC (Europe/Africa-Asia), and 3-5pm UTC (America-Middle East).
- For plenary sessions with maximum synchronous attendance around the world, while there is no ideal time, there is 1-hour where most of the world is awake: 2:30pm GMT allows most of the world to participate before midnight and after 6:30am. (Except New Zealand)
- Organizers can pick a time zone and use it consistently. While this may be inconvenient for some participants, it is simple and predictable. The time zone can change over the years.
- Presentations can be [recorded in advance](#), and then streamed at specific times.
- Presenters can make one live presentation at some convenient time for them; this interactive presentation can then be recorded, replayed at a two or three other times during the following 24 hours, and then uploaded to a video store service, where participants in other geographic locations can watch asynchronously in “Catch Up” mode or after the event. Volunteers can collect questions by asynchronous participants. A separate live session can be scheduled with the speaker for answering those questions.

Alternatively, presenters may be asked to prepare a recording that is played during the times they are not live.

- Presenters can make multiple live presentations, possibly over multiple days, with at least one happening at a time that is appropriate for large time zone ranges. For example, 8am GMT (good for Europe through far-east Asia and Australasia) and 5pm GMT (good for the US West Coast through Europe).
- Smaller events, such as workshops, can be independently scheduled for the time block that is the most convenient to the registered participants.
- Sessions can happen on a 24-hour rolling basis, scheduled according to the geographic location of the speakers. In this staggered model, there are three sessions each day, and attendees pick two of three, depending on their location: each attendee, however, will likely miss one third of the program altogether.
- Breaks should be longer than 15 minutes, because a short bio-break for some may fall on meal time for others.

2.5 Carving out Mental Space

One thing that physical travel to conferences accomplishes is help carving out the mental space for the participants. Virtual conferences do away with physical dislocation, and therefore it becomes much harder for participants to “be” at the conference. However, synchronous virtual events encourage attendees to prioritize real-time participation and discourage the illusion that they will come back to some session later. Survey results show that participants value events that are designed to help with this (e.g., “I liked being able to watch the talks at my convenience but I probably watched fewer and was less engaged in discussions because of it.”).

Virtual conferences may have multiple audiences -- one set of attendees wanting intense interaction over a short period and another set wanting more casual interaction with archival material. Formal paid registration and special events for registered participants could focus on attendees desiring intense interaction.

One tension for organizers is whether to spread synchronous events out over more days to make it easier to combine virtual attendance with daily life or whether to encourage more intense interaction over a shorter period of time. Even at in-person meetings, multi-tasking can be common and there is often a limit to how much dense technical information can be consumed in one day. Without the need to limit travel time, we might settle on ~3-4 hours per day for virtual conferences rather than ~9-12 for in-person meetings. This also makes [dealing with time zones](#) easier. An in-person event that was normally 2-3 days might translate to a week-long virtual event, but without the travel time/expense/environmental impact and with more ability to attend to other duties² and absorb complex ideas.

² Obviously, this is particularly a concern at times when the move to a virtual conference is motivated by an external crisis, e.g. as during the COVID-19 crisis, when many researchers are also juggling childcare and other family responsibilities.

Participants should be advised to clear their calendars for the conference, discuss attendance with their employers, and be aware in advance that distraction may be an issue. We will likely need to develop new socially acceptable strategies for being physically present but mentally absent, especially when virtual conference attendance requires shifting to a different time zone for work hours for a few days. Participants may find it easier to attend virtual conferences from home rather than work and conferences could consider providing some form of certificate of attendance for help with verification of participation.

2.6 Registration

In virtual conferences, registration is important not just for regular planning purposes, but also for dealing with time zones and for guiding technology choices. However, some of these very technology choices may be in direct conflict with the goal of having all or most participants register. Technically, the simplest thing organizers can do is to have speakers pre-record or broadcast talks publicly to the entire world, e.g., livestreaming to YouTube. Livestreaming may also be required for other technical reasons, for example for allowing these streams to be viewed in experimental platforms, such as VR. But that puts the value of registering for a virtual conference in question.

Registration for virtual conferences is important for:

- **Content:** Organizers may choose to limit the live distribution of sessions to only registered participants and make those sessions publicly available at some point later. Alternatively, organizers may want to livestream the sessions publicly. Both options are technically possible. This decision has strong implications on the [technology choices](#), as some platforms (e.g., Zoom, Crowdcast.io) support restricted participation while others (e.g., YouTube, Twitch) do not.
- **Planning and communication:** Organizers may want to limit real-time social interaction to only registered participants. Alternatively, organizers may open up the social interaction channels to the entire world. Both options are technically possible. But without registration, organizers will not know who wants to participate, so it will be hard to plan -- 30 people? 300 people? 3,000 people? In what parts of the world are they? How do we send them information?

For these reasons, we strongly recommend that virtual conferences require registration and that they limit social interaction to those who do. Additionally, there are [financial](#) and [security](#) implications, discussed below.

One issue to bear in mind, at least this year, is that conference platforms may not be ready for interfacing with the registration services that we have been using for physical conferences. In virtual conferences, moreover, the check-in procedure is considerably different. Here are some issues to consider:

- Some of the systems listed in the section on [Platforms](#) include support for registration, others do not.

- There may be interfacing work needed to connect a registration system and the conference platforms, e.g., manual transfer of CSV files.
- Some of the interfacing work may fall on the organizers themselves, rather than on the registration vendors, at least until vendors support online check-ins.
- Contracted registration vendors will no longer be asked to travel and do on-site registrations, so it may be appropriate for pricing to change.

2.7 Finances

At this time, we have only a few data points regarding the finances of virtual conferences: the long-running OpenSimulator Community Conference has free registration (via [EventBrite](#)) but accepts “Crowdfunder” style donations; some conferences that have gone virtual in the first stages of the COVID-19 crisis have offered participants free registration (e.g., ASPLOS) to reduce the sudden workload on the organizers; others are reducing or eliminating fees for virtual *attendees* but requiring that one *author* per paper register and pay (e.g., IEEE VR), to help offset sunk costs and pay for new expenses. However, even in this unusual time, charging real registration fees will help in many ways: besides avoiding emptying the coffers of sponsors, it will provide better estimates of how many people will be attending (which is important for provisioning resources), and it will give organizers better data that will help inform the ACM Task Force on Virtual Conference Experience (the new task force, distinct from the present one, whose brief is to take a longer-term view of virtual meetings) analyze budgeting in the longer term.

The move to virtual conferences may drastically change the number and distribution of people who attend. Indeed, [ASPLOS 2020](#) is reporting that over 1,000 people -- more than twice the normal number of participants in recent years -- registered for the online conference, but perhaps this number would have been lower had registration not been free. Similarly, IEEE VR reported over 2,000 people, also more than twice the normal number of participants, with more geographical and gender diversity.

How should the registration fee be set this year? At this point, we can't offer confident advice about numbers (see [this appendix](#) for a preliminary analysis). However, there is a good argument that registration fees should *not* be set at \$0, even this year. Rather, organizers should look at their existing budgets and rework them by eliminating the costs associated with the physical event. Virtual conferences that do choose to set their prices low should be careful not to encourage an expectation that other virtual conferences (or future instances of this one) will always be free or cheap. (For example, one of the suggestions heard by the ASPLOS organizers was “keep it free;” obviously, this may not be financially sustainable.) A survey after the [ACM UIST](#) online program in October 2019 asked attendees how much they would pay, and they answered anywhere from \$25 to \$200. IEEE VR asked a similar question of its more than 2000 registered attendees.

Another consideration for conference budget planners is the possibility of sponsorship, which plays a large role in the budgets of many physical conferences. Fortunately, many of the motivations and benefits of sponsorship (from the sponsors' point of view) carry over well to the virtual setting—indeed there are even some new ones! These options can and should be explored this year: organizers can quickly renegotiate their sponsorship arrangements to target online visibility. See [this appendix](#) for more discussion.

One final short term issue for conferences that had already planned in-person meetings for 2020 is cancellation policies for hotels and airlines. Sponsoring organizations may have ongoing relationships with hotels that give them some leverage. This could also be one additional good argument for offering a mechanism to request waived registration fees in reaction to the COVID-19 pandemic, but it is probably better for setting expectations long-term if we set a reasonable registration fee and then waive it where appropriate, rather than not charging any registration fee in the first place. Some conferences may need even higher fees this year to cover deposits on venues and services that will go unused (as was the case with IEEE VR).

2.8 Preparing to Deal With Disruption

Large gatherings of people offer attractive targets for deliberate attempts at disruption, trolling, and other attacks. Conference organizers and platform developers should view their offerings ahead of time through the lens of possible disruptions. Many platforms offer controls such as “Mute all microphones” or “block this participant.” However it is difficult for the presenter to manage these controls in real time without interrupting the presentation. This is one of many reasons to have other volunteers/staff in charge of that aspect and to actively assign co-host privileges ahead of time to those people. Consider creating a specific “Security Officer” position for this task.

It is also prudent to have an explicit Code of Conduct that sets down rules for participants and the types of actions that will be taken when violated. Consider including things like a real name policy for attendees (similar to wearing a badge) and guidelines for whether it is acceptable to take screenshots or record other participants (e.g., recording not allowed, or allowed for personal use but not for further distribution). IEEE VR 2020 pre-registered all attendees in Slack and Mozilla Hubs with the full name they used for registration; in Hubs, attendees could change their nickname, but their real name was also visible and could not be changed. “Reception” areas may be considered where participants arrive and get screened, briefed, have audio checks, etc., before being moved to the main meeting. Beyond these specifics, consider testing your platform with an eye toward attendees being as disruptive as possible and then building in defenses for these kinds of disruptive actions.³ For example, what would happen if an attendee attempted to impersonate a respected member of the community, or if an attendee posted

³ [Black Hat Trolling, White Hat Trolling, and Hacking the Attention Landscape](#), Matthews and Goerzen, 2019.

offensive comments or links to malware in the chat? What if many attendees did this at the same time?

Appropriate defenses may include both prevention strategies and support for investigation, response, and censure after the fact. Above, we pointed out that virtual conferences will need at least as many volunteers as a physical conference; indeed, depending on how the virtual spaces are organized, they may need many more. When there are many small virtual spaces, be they text channels or 3D environments, moderators become increasingly important as these events become more open to the public. For example, IEEE VR 2020 had almost double the number of volunteers as would have been normal for the physical event, and they were still stretched thin as they monitored and moderated Slack, Sli.do, and Hubs.

For ACM conferences, organizers could emphasize to all participants that the [ACM Policy Against Harassment at ACM Activities](#) applies equally to virtual events and that harassment will not be tolerated in any shape, form, or medium. Other organizations may have similar policies and if not may want to consider adopting one.

2.9 Fairness and Inclusiveness

Another issue to consider when planning a virtual conference is ensuring that existing socio-economic disparities are not amplified by the rapid move from physical to virtual. For example, one might envision technically sophisticated solutions that would be out of economic reach for many communities; or long interactive sessions that are at odds with child care duties of the participants.

Some platforms may not be accessible in some geographic regions. For example, Google, Facebook and YouTube services may not be easily reachable in China. If possible, organizers should test availability and quality of services from regions where people have registered.

Many participants will need to watch and listen from home, but their internet connectivity may not support high-bandwidth streaming video. Thus, offering a fall-back option that allows asynchronous downloading or audio-only participation, including dial-in by phone, can ensure that nobody is excluded by network constraints. This applies particularly to presenters, whose at-home bandwidth may not be sufficient to reliably stream video, and whose housing situation may not offer a quiet space for remote presentations. (Make sure to check whether the platform you are considering offers local dial-in numbers across all regions of the world!) Giving presenters the option to present via pre-recorded video, even if you wouldn't normally consider this for your physical event, should be strongly considered.

Many organizations have established playing-field-leveling tools (student travel grants, geo-diversity grants, etc.) that could be repurposed to help level the virtual playing field, but we may also need to consider new mechanisms. First-class access to virtual spaces may require

large up-front investments in, for example, network infrastructure; in some parts of the world, this may raise significant hurdles.

2.10 Accessibility

As in physical conferences, accessibility touches all aspects of a virtual conference, from platform selection and budgeting to digital resources and online logistics. We recommend appointing an Accessibility Chair to the conference committee and including them in all phases of planning.

The Accessibility Chair will be responsible for:

- **Helping with the selection of accessible platforms and tools.** For example, organizers should consider whether tools used for live sessions can be readily used with screen readers, screen magnification, live captioning, and other assistive technologies and services. Tool vendors often provide accessibility information on their websites.
- **Working with attendees** to ensure the necessary access services are included. Many people with disabilities have ample experience of what works for them to collaborate remotely. Rather than assuming or guessing, work with your attendees to see if there are particular tools or particular ways of using tools that maximize their experience.
- **Helping to plan and budget for access services.** Compared to in-person events, it may be easier to find high quality remote services like sign language interpretation or captioning. Some attendees may already have access to interpretation or captioning services that can be used at no cost to the conference. Others may request services from the conference itself.
- **Establishing best practices** for preparing and running accessible sessions. Following existing practices developed by the accessibility community for running online meetings can benefit all participants.

If you do not have ready contacts to help you plan for online accessibility, consider contacting universities that have a large number of blind or deaf students. For example, Gallaudet University has a small computer science group that has advised U.S. federal and state policy makers on how to support participants who are Deaf.

Participants who are Deaf and located in the United States may be able to use a dial-in conference line with their government-subsidized [video relay service \(VRS\)](#). The participant dials the conference number and a communications assistant at that service will translate the conference audio presentation into sign language, visible on a screen used by the person who is Deaf. This incurs no extra cost for the conference, but does require that the conference tool support dialing in by phone. Some organizations also have on-staff sign language interpreters. If they can participate in a Zoom, BlueJeans or similar video conference, they can provide real-time interpretation. The IETF standards organization relied on the services of a captioner assigned to one of the attendees through his job to provide real-time captioning for all attendees.

In the United States and other countries, there are also commercial CART (communication access real-time translation) services that will provide real-time captioning, i.e., translating speech into text, for a fee. The text is typically shown to the participant on a web interface. Some of these services specialize in captioning meetings with professional content, i.e., their staff are trained to recognize and correctly transcribe at least some scientific and engineering terms. Some platforms (e.g., Zoom) allow organizers to designate a participant to provide real-time captioning.

For pre-recorded content, some video services such as YouTube can auto-caption stored videos. These captions need to be edited by the presenters for accuracy. Although automated live captions are available on several platforms, this is not yet an appropriate substitute for human-powered live captioning. Unlike humans, AI-powered captioners cannot handle imperfect situations such as background noise, overlapping speakers, and poor audio quality. They are also limited in their ability to accurately transcribe technical content with specialized vocabularies.

For information on best practices, accessibility features of commonly used tools, or other questions around virtual conference accessibility, please reach out to [ACM SIGACCESS](#) or the SIGCHI [AccessSIGCHI](#) group, who have been gathering [resources and guidance on accessible remote conferences](#).

3 Technology

This section describes the platforms and technology available right now to support virtual conferences. We begin with the options for [conference hosting](#), and then discuss the [requirements for participants](#).

3.1 Conference Hosting

3.1.1 Specific Platforms and Tools

In a separate document (for easy viewing), we have prepared [a set of tables](#) comparing and ranking many open-source and commercial platforms along the following dimensions:

- Maximum number of users
- Cost
- Technical requirements
- Media support
- Recording and archiving
- Attractive features and limitations

The platforms we compare are divided into several categories:

- **[Videoconferencing services](#)**: these are commercial services, both free and paid, that are capable of hosting audio-visual sessions with multiple simultaneous participants, from just a few to hundreds or thousands. Typically, they also support screen sharing. *These systems are a good fit for the media-rich, highly interactive sessions (many-to-many and real time interaction) of a conference as well as for conference planning.*
- **[Videoconferencing platforms](#)**: these are downloadable software, typically free, that allow conference organizers to host their own videoconferencing services. They are only suitable for technically sophisticated organizers.
- **[Livecasting and Webinar platforms](#)**: these are both commercial and free solutions that are capable of broadcasting live audio-visual streams to a large number of view-only participants, typically with an optional text channel for the viewers. *These systems are a good fit for plenary sessions, especially for medium to large conferences.*
- **[Conference hosting services](#)**: these are services that provide turnkey solutions for hosting conferences.
- **[Text-based \(mostly\) platforms](#)**: these are commercial and free solutions that support large group moderated text chat, typically with additional options for 1-on-1 text and audio. *These systems are important for all stages of a conference, from planning to live events. They can also support asynchronous poster sessions.*
- **[Shared whiteboards](#)**: these provide shared whiteboards/workspaces and may offer better capabilities than the generic shared whiteboards of videoconferencing systems.
- **[Virtual worlds or virtual reality systems](#)**: 3D environments where a user is presented as an avatar or full-blown 3D VR systems. *At this point, they still require a considerable investment on the part of both organizers and participants, but they are an option for communities who want to experiment.*
- **[Archival storage systems](#)**: These are for long-term storage of conference outputs: papers, videos, and perhaps questions in poster/demo sessions.
- **[Miscellaneous tools](#)** for asking questions, virtual telepresence, and emulating a physical space.
- **[Unevaluated](#)**: tools and systems we've heard about but have not used or evaluated yet.

While the linked tables are an essential companion to this document, the information is more manageable when presented in tabular form; therefore we have found it convenient to keep it separate from the body of this Guide. Additionally, a more abstract model for communication systems can be found in [this appendix](#); the appendix also elaborates on the terms used in comments in the table to describe the “Modality” dimension for each platform.

3.1.2 “On-Site” AV and IT Support

Behind the scenes, a virtual conference is something like a live TV production. As such, it needs real-time audio-visual support. This might include operating tools such as the Open Broadcaster Software ([OBS](#)), starting and stopping the live sessions, making sure the right speakers are in the right virtual spaces before their sessions, testing their microphones and presentations

before going live, switching speakers during the sessions, making sure the session is being broadcast/recorded, dealing with technical and security disruptions, etc.

These activities fall, generally, under the responsibility of the host. For all but very small meetings, it is important to have someone serving as host who is not involved in the content of the meeting -- not a presenter, not a session chair, and not the student volunteer helping the session chair. For very small meetings, this could be the same person, but the two roles do require different skills and expertise (platform controls vs. content expertise). The analog in physical conferences is the activities performed by the A/V team and Hotel security vs. the session chair and the volunteers who shuttle physical mics around the room, etc.

This “on-site” A/V support can either be provided by a group of volunteers who are part of the organizing committee, or it may be contracted externally, or a mix of both. Some providers of A/V services for physical conferences are starting to branch into virtual conferencing services -- this is a service layer on top of the platforms presented above. The exact contour of this support depends on the platform. It is no exaggeration to say that A/V operation is the key to the technical success of the virtual conference. Therefore, *it is critical that organizers identify early on who will operate the platforms where the conference will take place.*

In case the organizers chose to operate A/V themselves, a reliable network with high bandwidth is essential, especially if something like OBS is being used, and particularly if there are multiple parallel sessions. Running out of a University may be an option, but organizers should make sure their university allows this use of their network and that any firewalls are open to whatever software they choose. Some online cloud services support software such as OBS, but make sure to get quotes that include bandwidth costs (which could be significant) or choose a provider that does not meter bandwidth.

Finally, it is wise to set up a back channel for out-of-band communication between the organizers, the speakers, and this team. Considerable backstage communications need to happen for a virtual conference to run smoothly.

3.2 Requirements for Participants

3.2.1 Hardware

For conference presenters, it is possible in principle to participate using only the built-in microphones, speakers, and cameras on their laptops or desktops. However, these tend not to be of sufficiently high quality. Specifically, built-in microphones, especially on laptops, tend to eagerly pick up other ambient sounds besides the speaker’s voice -- keyboard typing, chairs squeaking, doors opening, dogs barking, etc. Also, the built-in microphone and speakers, without echo cancellation, frequently result in feedback loops that ruin the experience for everyone. For this reason, it is important for presenters to look into buying, renting, or getting access to better hardware, perhaps with the help of their own institutions. They should also be

careful to check their A/V setup ahead of time, in particular making contingency plans if something fails during a live presentation. Specifically, it is a good idea to ask presenters to understand how to use text chat channels to speak with the session organizers. They can also be asked to keep a phone handy in case they need to revert to calling in on a phone line; this is supported by most videoconferencing systems in widespread use today.

A relatively affordable and effective option is to use headsets with embedded microphones. Earphones for smartphones generally work well, though presenters should be made aware of the noise they may introduce when they come in contact with clothes and hair. Gaming headsets are another alternative that avoids the problems of earphones; they are popular, not very expensive, and designed for being worn for several hours. Other, more expensive, alternatives include noise-cancelling speakers (e.g., Jabra) or microphones designed to be used by podcasters, streamers, and vloggers (e.g., Blue Yeti); but be careful: just buying one of these microphones doesn't guarantee full benefit; one also needs to pay attention to how it is situated and mounted, and headphones are still required because the microphone will pick up computer audio. In some cases, a laptop's built-in microphone can sound better than a headset's. The audio quality of different options available to the presenter can be checked as part of a test session.

Another issue is the lighting that the presenters use for their faces, as well as the angle of their camera. Many people do not realize that strong light sources, such as a window, behind them will turn their faces dark and grainy. Again, this is an issue that can be detected and mitigated during test sessions ahead of time. [Ring lights](#) are a cheap and effective option for presenters to add to their setups, as are the flat LED panels that are recently replacing soft-boxes for professional video and photography; these can help make a more consistent lighting environment. There are many online resources aimed at gamers wanting to set up high quality video streaming environments, targeting any budget from a few hundred to many thousands of dollars, and their advice applies equally well here. Professional-level results often depend on the camera; if a presenter has a high quality DSLR or Mirrorless camera, they might be surprised to learn it can be used to do high-quality video streaming.

3.2.2 Internet Connectivity

During the COVID-19 crisis, presenters may have no choice but to present from home, where internet bandwidth and reliability may be significantly lower than, say, at their workplace. Networks in some geographic regions may experience congestion that varies with the time of day, due to the increase in overall usage. Thus, organizers need to plan for handling unexpected disruptions or severely reduced quality during a live talk. For example, they may want to have a recorded version of the talk as a backup, in case the live presentation fails just before or during the presentation. Or they can have presenters dial in by phone in addition to their video link, muting that backup connection until it is needed (with the A/V crew then sharing the slides).

Presenters should ensure that their home internet connectivity is not degraded by simultaneous use by other members of their household. (And hold the popcorn until after the presentation: microwave ovens are known to interfere with Wi-Fi.)

Similarly, not all attendees may be able to watch live video reliably; providing downloadable content (e.g., MP4 files, not just YouTube URLs) may be helpful. Zoom and similar services can record sessions in MP4 format and store the recorded content in the cloud, with download links that can be distributed to attendees.

3.3 Security and Privacy Issues

Virtual conferencing platforms are experiencing a sudden burst of use as the COVID-19 pandemic drives communities worldwide to interact over the Internet. In one of the most rapid technical adoption trajectories ever seen, these platforms are suddenly being pressed into service for new uses throughout everyday life. As a result, virtual conferencing tools are suddenly drawing intense scrutiny, sometimes for flaws in security or privacy that had already been noticed by researchers in the past. Any platform that enjoys substantial usage can become a target for attack, trolling, disruption, and surveillance. Numerous examples of such abuses were documented in March 2020, fueling a sudden concern over the problem and the coinage of the word “zoombombing” (which occurs when miscreants take over and misuse a publicly accessible video conference—for example, by projecting a desktop containing objectionable material).

Many new videoconferencing users are not trained in using these technologies or in underlying principles of online security and privacy. In most cases, adoption is taking place quickly and out of necessity, without much opportunity to consider important issues such as security training, threats to privacy, impacts on vulnerable communities, or laws such as the European Union's General Data Protection Regulation (GDPR) and the US Family Educational Rights and Privacy Act (FERPA).

In some cases, platform features can imply a level of privacy that is not truly supported. For example, messages marked as private between attendees may appear in chat logs available to hosts, without the knowledge of participants. Participants may believe that virtual backgrounds will obscure private details on their surroundings, but the image process technology supporting virtual backgrounds can allow momentary views of the real background that can be isolated and examined in a recording.

These are important issues and we are glad to see companies like [Zoom](#) making rapid strides to address them. All in all, it is our opinion that these platforms, if properly configured, are appropriate for the virtual conference use case.

Virtual conferences often focus on content that is considered a “publication” suitable for wider dissemination, even if the conference itself is restricted to registered participants. As these platforms are pressed into service for new everyday uses (university classes, virtual conferences, religious services, birthday parties, department meetings, weddings, medical appointments, psychotherapist appointments, and even high-level government meetings), it is important to consider the additional security, privacy, and legal implications implied by these settings. Indeed, even for virtual conferences, as these platforms are pressed into service to facilitate more personal interaction between attendees, these issues are of increasing importance.

Here are some additional resources that may be helpful:

- Members of ACM's US Technology Policy Council (US-TPC) have written a broader [document](#) that lays out a set of 16 security and privacy principles for virtual meetings.
- The NSA has released a document [Selecting and Safely Using Collaboration Services for Telework](#).
- EFF has advice for how to [harden Zoom settings](#).
- Security expert Bruce Schneier finds [Zoom security](#) acceptable.

4 Nuts and Bolts

Now let's get down to technical details. In this section we first describe the interaction styles and communication requirements for all [components](#) of an online conference. Then we offer some specific platform and technology [recommendations](#) for conferences of different sizes, as a starting point for organizers.

4.1 Supporting the Parts of a Conference

Just like a physical conference, a virtual conference has many parts with different requirements.

4.1.1 Program Committee Meeting

The first step for most conferences is to choose papers. Since online program committee meetings are a well established practice at this point, we have focused most of our attention on the other parts of a conference in this Guide. But readers may be interested in a [nice chart](#) comparing physical and virtual Program Committees along several dimensions, compiled by Emina Torlak, the PLDI 2020 PC chair. Also, [this appendix](#) has some detailed experience reports; we invite you to add your own!

4.1.2 Plenary Sessions

A *plenary session* is one that all conference participants are encouraged to attend. In a plenary session, there may be administrative announcements, keynote addresses, panels, and award presentations. Plenary sessions are typically not run in parallel to other sessions, and they are intended to be of general interest to all participants—both of which lead to typically larger audiences (than, say, paper sessions).

Keynotes typically involve only one speaker and the session chair. Panels involve a very small group of people (typically around 5), with the panel leader serving as the session chair. Award presentations involve a relatively small group of people (typically under 20).

Plenary sessions require a communication system that allows a small group of presenters, hosts, and A/V support people to interact over audio/video/screen sharing, plus, critically, a broadcast video channel that supports a large audience. If conference attendees want to discuss a plenary session in progress or share relevant resources related to its content (which should be encouraged!), then either the broadcast platform or a supplementary concurrent platform needs to support text communication among the participants.

As an alternative to live presentations, organizers may choose to use a hybrid model consisting of pre-recorded talks with live Q&A. Pre-recorded talks can either be watched asynchronously or live-streamed, followed by a live virtual discussion. That pre-recorded talk can be archived in the Digital Library with the paper and/or rebroadcast at other times. The availability of videos for replay also helps if someone has limited bandwidth or compute resources, or if their Internet connection fails. Cautious organizers may request pre-recorded videos from their presenters even if they intend to present ‘live’ to insure against failure.

4.1.3 Paper Sessions

Paper (or breakout) sessions often run on parallel tracks, are typically grouped thematically, and typically involve several presenters, one after the other. Session themes can be chosen based on the accepted papers, provided ahead of time as guidance to submitters, or grown organically (e.g., in the “[unconference](#)” model). This requires a communication platform that supports several simultaneous 1-way video channels along with a parallel text chat sessions to ask questions of the speaker.

To make parallel sessions effective, and to facilitate “session surfing,” there should be an efficient method for attendees to know what is currently on or coming next, and how to find it (e.g., links on a website). Moreover, presenters need to have a clear understanding of how and what content to prepare for their session, and what platforms they will need to master to present.

4.1.4 Workshops, Doctoral Consortia, and Tutorial Sessions

Workshops and tutorial sessions can take many forms at conferences, including half-, full- or multi-day events. Larger ones may share many of the attributes and needs of whole conferences, including plenary and paper sessions, as well as more interactive or “hands-on” experiences, where attendees may be expected to prepare and/or bring equipment with them (e.g., laptops with specific software preinstalled).

Depending on the structure of the given event, much of the technology and support can be handled using the same infrastructure (e.g., screen sharing interaction with a particular software tool) as that of the main conference sessions. These sessions are often also smaller, depending on the nature of the topic.

4.1.5 Poster, Exhibitor, Birds of a Feather, and Demo Sessions

These sessions are even smaller and more intense than paper sessions or workshops, typically involving a presenter interacting with a just handful of participants. Poster and demo sessions can be supported by multiple small 2-way video channels, where participants can join a videoconferencing session with the presenter as moderator. Such sessions benefit from having a way for the presenter to share a screen, perhaps with a shared whiteboard.

Unlike physical conferences, where poster sessions are synchronous, a virtual conference also allows *asynchronous* poster sessions, where a poster can be made available for a certain period of time and registered participants can participate in a threaded chat discussion about the poster, with periodic inputs from the poster presenter, perhaps during scheduled live appearances. This can be supported by text-based discussion forum platforms such as [Piazza](#), [GroundAI](#), or [Ed Discussion](#)—especially ones that are able to provide alerts when new contributions are made to the discussion.

Specific requirements to think about for this kind of synchronous, small group interaction include:

- Ways of knowing what posters and demonstrations are available (e.g., poster/exhibitor/demo “fast forward”/teaser session).
- Ability to hop around between exhibits and posters
- Ability to see demos being done, with VNC-like control
- Ways to find out which posters or demos are popular
- Ways to interact with the creators or authors or to leave messages for others
- Virtual whiteboards that poster presenters can use to help explain their ideas

A possible direction that some intrepid organizers may want to explore is to use a virtual world or Virtual Reality (VR) platform for these sessions. While the technology for large-scale VR is probably not quite there yet for the main plenary sessions of a large conference, the expert consensus is that smaller events like poster sessions or immersive demonstration experiences

can work well in virtual environments. (IEEEVR 2020, for example, used a custom version of the [Hubs](#) virtual world platform for its poster, demo, exhibitor, BoF, and social sessions, spreading the events across almost 100 virtual spaces. The poster event had 140 posters over 36 rooms.)

4.1.6 Speaker Preparation

Presenters and speakers will need to keep in mind some practical tips, which should be passed on to them by the organizers via email and during short test sessions. These include:

- Use a quiet space, isolated from noises from pets, family members and others, if possible.
- Turn off phone ringers, and be mindful of anything visually distracting in the background (or use the virtual background feature offered by many videoconferencing tools).
- Prepare some drinking water (just as what's provided at speaker lecterns) and set a timer (since there may not be any session chair timing feedback).

In a traditional in-person event, speakers give their presentations once and respond to questions. Many of the proposals in this document involve asking speakers for significantly more time — giving several presentations in different time zones, preparing an archival presentation (with additional pressure to perfect/polish), preparing a video of the presentation in advance of any live presentations as a backup in case there are technical problems in the live session, monitoring and responding to questions in a text-based forum for the duration of the conference (as well as before and after the conference), preparing a 30-second video “teaser” of their talk to help attendees choose which virtual sessions to attend, etc. Some presenters may welcome increased visibility and increased opportunities/additional formats in which to deliver their message (somewhat like preparing the 1-sentence, 3-sentence, 5-minute, 15-minute versions of your “elevator pitch” when attending a conference). However, other presenters may push back on increased expectations without prior discussion and buy-in. Similarly, if organizers opt for live presentations with backup videos just in case, they should be prepared for many presenters to want to use those videos instead of doing live presentations, since they already put in the effort to make them. *Organizers will need to find the right balance for their community.*

4.1.7 Archival storage

At the end of a conference, papers and videos may need to be archived in a suitable platform. Some alternatives are presented [here](#).

Indeed, in a virtual conference, unlike a physical one, *all* interaction can be preserved, not just papers and talks. It is even technically possible to archive and mine audience interactions. These possibilities come with challenges. Many physical conferences that stream talks do not stream the Q&A, for example, because it may dissuade discussion and because it is not feasible (or reasonable) to obtain recording releases from all attendees.

Although it is very easy to collect data in virtual conferences, we urge conference organizers to be very careful about using virtual conferences' data for research! There are often additional steps that must be taken first before studying participants including explicit consent from study participants and pre-approval from an Institutional Review Board (IRB), Research Ethics Committee (REC), or similar body. As a matter of principle, no data that is reasonably expected to be transient (e.g., chats, emoji reactions, etc.) should be stored anywhere by anyone. The participants themselves must be made aware of this, lest some of them deploy bots or activate recording features that collect this kind of data. Any data storage will require consent from the generators of the data.

At IEEE VR 2020, there was a team of “official videographers/photographers” and a separate university team that obtained consent from a local IRB to observe the conference and run a post-conference questionnaire. A subset of the virtual spaces were marked as explicit “observation/recording spaces,” and only those spaces were used by researchers or the photography team. All attendees were informed that they were not otherwise allowed to use the online event as a research platform.

4.2 Bootstrap Suggestions

We have covered a lot of ground in the discussions above; organizers looking for quick advice about how to move their conference to a virtual setting may be left wondering where to start! This section offers some concrete suggestions that can be used as starting points for organizing and choosing technology for conferences. We begin with some simple steps to take if you are going virtual under a time crunch. We then move on to focus on suggestions for conferences of three different sizes.

These suggestions are not intended to promote a specific system over its competitors; rather, they are intended as examples to bootstrap conversations within organizing committees. In particular, “Zoom” should be understood to mean any of a number of similar teleconferencing systems, though we ourselves are satisfied users of Zoom.

4.2.1 Going Virtual with Low Overhead

If organizers do not have the mental cycles to produce a highly interactive, high-quality virtual conference, there are a few things they can do to continue to support the dissemination of research while adding some elements of synchrony to bring the community together. Again, organizers should take these as “bootstrap suggestions” only—starting points for discussion—and should feel free to experiment with other options.

First, ask authors to [pre-record their talks](#) and upload the videos to YouTube or Vimeo. Link those videos from the conference website. This involves very low overhead on the part of the conference organizers, as they do not have to deal with supporting live presentations of talks. Additionally, set up a few synchronous sessions for Q&A with groups of authors and panels

using one of the videoconferencing and/or Webinar systems (e.g., Zoom). Consider also setting up a Slack workspace for participants to chat before, during, and after the live sessions. The links to these live sessions can be disseminated in Slack. If the organizing team has enough cycles to set it up, it should be relatively easy to broadcast keynotes using Zoom webinars or Crowdcast.io (other options are possible) for larger audiences. In the same vein of low overhead for conference organizers, workshop organizers can easily self-organize into video conferencing sessions, with some coordination on the part of the workshop chairs.

Make sure to talk to your sponsoring organizations on what to do about registration fees. Within the ACM, for example, Special Interest Groups (SIGs) are the internal structures financially responsible for conferences. There may be other ways for them to absorb some incurred costs, but sustainable financial models of some kind will be required long term.

The next few subsections offer “bootstrap suggestions” for situations when organizers have a bit more time to plan. They are grouped according to size, since the main issue to consider in planning a virtual event is the number of participants, which tends to correlate with the complexity of the conference. These concrete suggestions should be assessed in the context of the rest of this Guide: if there are a couple of months to plan, other alternatives can and should be considered.

4.2.2 Small Conference or Large Workshop

Size	Fewer than 200 participants
Events	Talks (all single-track), workshops
Platforms	Zoom Meeting + Slack
Before the conference	
Prepare “Venue”	Schedule one Zoom meeting per day, spanning the duration of the talks. Schedule separate Zoom meetings for each workshop. Pay attention to time zones and consider shortening the duration of the live sessions.
Navigation	Make a nice navigation page based around the online program schedule, with links to the appropriate Zoom meetings and Slack channels.
Community	Recruit student volunteers and session chairs. Define who is responsible for what sessions, and train them.
Prepare presenters	Invite your presenters for test sessions well before the conference starts. Make sure they have appropriate A/V equipment (especially good headphones and microphone), and that they know how to give their presentations.

Consent forms	Remember to collect consent forms from all presenters regarding recording and/or broadcasting their presentations.
During the conference	
Hosts	(i.e., the people on the A/V control board): drive A/V checks for speakers, be ready to mute/unmute people, be on the lookout for Zoombombing . Responsible for recording and streaming, if those options are chosen. Have two hosts, especially if the number of participants is close to 200. Ensure that all participants are initially muted and that only the host can designate a presenter.
Session chairs	Introduce the session and the speakers, keep time and flow, choose questions from the audience via hand-raise feature or text, close the session. When speakers go unreasonably long with their presentations, session chairs should have the power to cut them off.
Presenter(s)	(<i>See advice above.</i>) May share screen.
Student volunteers	Be visible as volunteers (e.g., using a naming convention). Greet newcomers to the shared chat channels in Zoom, answer questions from participants. Help prepare the presenters before the conference starts. Monitor chat channels. Organizers should devise a mechanism for volunteers to bring audience questions to the attention of the session chair.
Breaks	Consider fun activities during the shared breaks, such as stretching exercises or polling for the cutest pet or the best Zoom background, with an official award. Make sure breaks are at least 30 minutes, because of time zone issues.
Unstructured sessions	Consider breaking the audience into small random groups, e.g., using the “breakout rooms” feature of Zoom.

4.2.3 Medium-Sized Conference

Size	Around 600 participants
Events	Plenary talks, parallel technical sessions, workshops, tutorials, posters
Platforms	Zoom Webinar or Crowdcast.io, Zoom Meeting, Slack
Before the conference -- same as small conference, with the following differences:	
Prepare “Venue”	Schedule the sessions: plenary sessions as Webinars, parallel technical sessions as Meetings or Webinars, depending on size. Schedule should

	account for 20 min before for A/V checks. Prepare Slack channels for plenary sessions, general help, technical support, etc.
During the conference -- same as small conference, with the following differences:	
Plenary sessions	Have the presenters and the session chair as “panelists” of the plenary sessions. Everyone else is just in listening mode. Consider recording the sessions for archival storage and replay. If attendees span large geographic areas, consider scheduling additional Webinar sessions for replaying the recorded plenary sessions at different times during the same 24 hour cycle.
Other sessions	Depending on the expected size of the audience, choose either Webinar or Meeting. Consider recording and replaying for the same reasons as plenary sessions.
Posters session	One Zoom meeting per poster, with a nice web page that participants can use for navigating between posters or some other semi-structured way of presenting and previewing posters.
Breaks	Consider scheduling shared breaks as separate meetings, and doing fun activities together.
Unstructured sessions	Consider organizing fun things to do online, and/or encouraging participants to self-organize ahead of time for that purpose. Some platforms offer the option of random breakout groups of a specified size to encourage spontaneous meetings.

4.2.4 Large Conference

Size	Over 1,000 participants
Events	Plenary talks, parallel technical sessions, workshops, tutorials, posters, demos, commercial exhibitors, 3rd-party events (recruiting, etc.)
Platforms	Crowdcast.io or Intrado, Zoom Meeting, Slack
Before the conference -- same as medium-size conference, with the following differences:	
Community	Recruit a <i>large</i> number of student volunteers, session chairs, and hosts. Define who is responsible for what sessions, and train them.
During the conference -- same as medium-size conference, with the following differences:	
Demos	Similar to a poster session but may be more spread out in time, and with fixed start times throughout the day. Provide a nice Web page as navigation

	and entry point to the Zoom meeting rooms.
Commercial exhibitors	Similar to demos. Web page navigation is very important for giving visibility to exhibitors. Announce these events in social media under the conference’s accounts. If using Intrado, it has special support for this function that you may want to take advantage from.
3rd-party events	Facilitate and advertise but do not host. Have the other parties host those events in their own platforms at the time of your conference.
Unstructured sessions	Besides the ideas mentioned above, consider hosting a live music event or a twitch party. Consider having a separate committee for planning these unstructured activities.

5 Fostering Social Interactions

Informal, unstructured social interactions are one of the main reasons people travel to physical conferences—and one of the areas where people tend to believe virtual meetings are destined to fall short. Common concerns are that there are no obvious opportunities for “hallway connections,” that nobody is “trapped” at the conference and thus seeking people to talk to, and that not restricting access to an exclusive group of registered participants may change the social contract.

On the bright side, now that virtual meetings are a fact of life for the moment, there are many creative ideas floating around for how organizers can construct opportunities for unstructured and even serendipitous interaction. Some of these ideas have been tried before in the few virtual conferences the task force is aware of, as well as in some physical conferences that have experimented with additional online forms of social interaction, but the possibilities are relatively unexplored. Hence, although this is arguably the most important part of this Guide, our suggestions are somewhat tentative, because they have only been tried and tested on a few occasions. Additional untested ideas can be found in the [appendix](#).

All the [platforms](#) we discuss in this Guide can be used in many ways, and using them effectively may require support from *other* platforms that are part of an overall conference tool chest. In particular, in order to interact, people need to be able to *find* one another, and this can happen in a variety of different ways, depending on the amount of initiative expected from participants and the degree to which conversations are initiated around common interests.

At the most basic level, pairs or groups of individuals can be formed entirely by individual participants figuring out for themselves who they want to talk to. There are *many* specific mechanisms that might be used for this—so many, indeed, that it may be helpful for conference organizers to decide on just a few to explicitly suggest. For example:

- Participants can use out-of-band channels (e-mail, etc.) or conference-provided tools like message boards to set up conversations with people that they might have hoped to run into at a physical conference.
- A conference might provide a way for people to advertise their interests so that other people can identify areas of potential synergy. (Poster sessions are a particular instance of this idea.)
- To get larger, topically coherent groups to self-organize mostly takes a number of people taking the initiative. For example, there are more and more online journal clubs (e.g., [this one](#)). Solving this problem is relatively easy: conference organizers just need to encourage people to run their own small scale events. Adding relevant recommender systems promises to make this problem more efficient (cf. all kinds of [science recommender systems](#)). This sort of self organization is similar to things like “Birds of a Feather” sessions that are used at many large conferences.
- If the conference is using a virtual world platform (like Mozilla Hubs, AltSpaceVR, OpenSimulator, etc) for some of its activities, participants can upload a selfie/headshot for personal avatars wherever the platforms support them, and use the same avatar across platforms when multiple platforms are being used. This is helpful for identifying at a glance who is interacting, particularly for those who remember faces better than names.

A different alternative—closer to the “hallway conversations” model—is to use the platform itself to organize conversations, either randomly or thematically. For example:

- Replace coffee breaks with “Chat roulette” where organizers randomly create Zoom (or equivalent) sessions of 2-4 people. When someone decides they have had enough of one conversation, they can go back to the main room and choose a different group to join.
- One might also imagine allowing a human operator to participate in the formation of breakout groups or one-on-one conversations.
- Conferences using virtual worlds platforms can set up social rooms that can be used throughout the conference and encourage people to send messages to whatever chat system is being used when they are available to hang out and meet people.

Completely random assignments of people to groups can be replaced by algorithms that assign people to groups or one-on-one conversations based on topic similarity. (Indeed, past experience shows that such matching can even improve real-world conferences. This concept is central to the 2020 [neuromatch.io](#) conference.) Some tools that may be worth looking at include the 1:1 meeting facilitation system built into the conference app for SIGGRAPH Asia, [Titipata](#), [b2match.com](#), and [Whova](#).

There are many other ways of using available technology to enhance social interactions at conferences. Here are a few ideas:

- Invite participants to make a list of 4-6 people that they would have hoped to run into at the conference, then send emails to these people to schedule half-hour video chat sessions at some point during the conference.
- Conversely, organize “virtual lunch tables” where a senior member of the community is placed at a table and then others (e.g., students) can sign up to join the table for a certain length of time. Or consider a lunch model where participants are randomly assigned to tables, with the intent of having different groups for every meal.
- Consider chill-out corners — places where people can just join and chit chat in some virtual places during the breaks, even with coffee in their (physical) hands or a drink.
- Provide a way for participants to advertise “sign-up sheets” (e.g., links to a Google Sheet with a list of open meeting slots and an invitation for others to fill in their name in the slot they want) that others can fill in to schedule one-on-one sessions.
- Expand the time allocated to (virtual) poster sessions, where participants can wander around and gather in small groups to discuss posters displayed in the virtual space.
- Science Meetup: The idea is to match like-minded scientists who have not met before: at morning coffee every day [time-zone matched, or across time zones], 5 minute minimum time; each swaps one slide (from initially registered set in a conference list).
- Scavenger Hunt: Questions could encourage people to dig into the papers or presentations, individually or in teams. Awards/acknowledgements for winners.
- Consider spaces for speakers to meet each other (a “speakers’ lounge” room or a speakers’ Zoom session for introductions).
- Consider ways to highlight speakers to attendees (similar to speaker badges at physical conferences) and perhaps special breakout rooms for attendees to continue asking questions of a speaker after their talk.
- Consider if a virtual version of “badge ribbons” make sense. At many physical conferences, attendees can get ribbons of various sorts and stick them to their badges--e.g., “my first time at this conference.” (In some cases these can become quite complicated, including your interests, your status and even puzzles — you need to meet a certain number of people to decode the puzzle).
- Mentoring: take one of the previous suggestions and place it in the context of mentoring sessions.

6 Other Resources

Good places to start:

- The Nearly Carbon Neutral Conference [white paper](#) and a [recent article](#) on this long-running virtual meeting; the white paper is long, detailed, and informative
- University of Alberta’s [Virtual Conferencing TOOLKIT](#); they have been doing this since 2013 and their white paper is long and informative
- [How To Run A Free Online Academic Conference](#), a comprehensive “workbook” full of questions that virtual conference organizers should be asking themselves

- [Virtual event suggestions for open source communities](#), a Linux Foundation blog post by Angena Brown, Shubhra Kar, and Jason Perlew including detailed comparisons of some major open-source tools
- Also, there are several detailed experience reports in [this appendix](#).

Other useful discussions:

- A [comparative slide deck](#) on four major virtual conference platforms (Intrado, Convent, Digitell, Crowdcast) by Juan Miguel de Joya
- [Notes for Presenters](#), by Yolanda Gil
- [How Should the SIGCHI Community Distribute the Cost of Publication?](#), by Julie R Williamson
- SIGCHI's [advice](#) on video production
- [Thoughts on "GDC \[Game Developers Conference\] in VR"](#)
- ["Ten Simple Rules for organizing a non-real-time web conference"](#) at Plos Computational Biology
- Rob Lindeman's 2009 short paper on [running a PC meeting in SecondLife](#)
- Welch, C. J., Ray, S., Melendez, J., Fare, T., & Leach, M. (2010). Virtual conferences becoming a reality. *Nature chemistry*, 2(3), 148-152.
- Srinivasan Keshav's 1994 paper [Experiences with Large Videoconferences on XUNET II](#), an early foray into this area
- Crista Lopes' [blog post](#) and Austin Tate's [blog post](#) on the experience of involvement in the fully virtual OpenSimulator Community Conference, 2013
- Erickson et al's paper "Synchronous interaction among hundreds: an evaluation of a conference in an avatar-based virtual environment" from CHI 2011; <https://dl.acm.org/doi/abs/10.1145/1978942.1979013>
- Blair MacIntyre's series of blog posts on IEEE VR 2020, starting [here](#)
- A thoughtful blog post by Eric Schliesser arguing [AGAINST Zooming/Teams \(etc.\) Department Colloquia and Conferences](#)

Other links:

- Crista Lopes's [keynote at UIST 2019](#) on virtual conferences and climate change
- The [SIGPLAN Climate Committee Report](#), which (among other things) discusses a number of alternative models such a physical/virtual hybrids, multi-hub conferences, and regional conferences, with an eye to reducing carbon footprints
- Microsoft Academic's post on [Impacts of COVID on the CS research community](#) offers "an analysis [already somewhat dated] of the COVID-19 impact on the computer science (CS) research community"
- The [Virtual Conferences section](#) of [Flying Less in Academia: A Resource Guide](#), a huge collection of resources on reducing conference travel
- Meredith Reitman's [Guide to Using Zoom](#)
- Major League Hacking's [Response to COVID-19](#)

- [Virtual Collaboration Spaces: Bringing Presence to Distributed Collaboration](#), Tate, Hansberger , Potter and Wickler (2014); a study of collaboration using a mixture of web-based tools and virtual worlds for asynchronous and synchronous interactions
- [The Virtual Oil Rig - Simulation-based Immersive Training](#), Tait, Hetherington and Tate (2017)