

Towards Climate-Friendly Internet Research

Edited by

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Abstract

This report presents guidelines for deciding when virtual or hybrid conferences are suitable and how to design them. The report is the output from a Dagstuhl seminar where the goal was to review the current status of virtual conferences and to develop best practices for hybrid conferences. The participants provided input on the state-of-the-art of virtual conferences: what works, what does not, and what needs improvement. From this discussion, the participants discussed the requirements, implications, and guidelines for designing hybrid conferences. The participants felt that in the future, small research meetings will move entirely online whereas larger ones will be held as hybrid events.

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1 Executive Summary

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Goals

The Internet was originally developed to ease collaboration between remote parties, thereby, in principle, reducing carbon emissions by a reduced need for travel. Yet, conducting research on communication networks has typically involved a certain level of carbon footprint. One fundamental reason is the publication and dissemination culture in the field, which focuses on conferences and workshops rather than journals. Not only does every dissemination of a research result therefore involve travel, even the peer-review process to decide which papers to accept, in the form of an in-person technical program committee (TPC) meeting, also requires travel. Moreover, although the standardization of Internet technology within the Internet Engineering Task Force (IETF) largely involves online discussions and audio/video streaming—unlike almost all other standardization bodies—yet regular in-person meetings



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are considered critical to converge discussion and build consensus. Thus, conducting and disseminating networking research has resulted in a high level of travel, and a consequent high carbon footprint.

The carbon footprint of these trips (mostly air travel) can, however, be reduced by means of organizational changes and virtual conferences. Recently, as a consequence of the COVID-19 pandemic, we have already witnessed a rapid transition to a virtual mode of operation including remote working, online meetings, and virtual conferences. This has resulted in first-hand experience in carrying out research but with no travel.

In this Dagstuhl Seminar, we initiated a discussion on how to make Internet research more climate friendly. Specifically, we evaluated experiences in running and participating in virtual conferences as a consequence of the COVID-19 pandemic. We wanted to understand what went well and what went badly in implementing and deploying virtual conferences, what challenges were encountered, and what needs to be improved, particularly as we transition to hybrid in-person, online meetings. The broader goal of the seminar is to identify how to transition to a new status quo that continues to reduce the carbon footprint from travel.

Structure

The seminar lasted 2.5 days. It began with an introductory round where each participant presented one slide to give an overview of their experience that was relevant for the seminar and a set of open questions that the participant wished to discuss during the event. These slides were collected from each participant before the seminar. We also had one invited talk (§3.1) that we used as a basis for triggering discussions and identifying areas for group work, while a major portion of the seminar time was dedicated to breakout sessions, whereby participants were split into small groups to discuss specific themes and develop ideas with consensus to propose to larger groups. The morning sessions the following day were dedicated to continuing parallel group work with presentations that reported the outcomes of each breakout session from the previous day. Every evening, we had an online social activity. The afternoon of the third day was spent reviewing and collecting feedback from the participants and for initiating follow up actions identified during the seminar.

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3 Overview of Talks

3.1 Invited Talk: Virtual Conferences (and Climate Change)

Cristina Videira Lopes (University of California – Irvine, US)

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Cristina Videira Lopes (UC – Irvine) kicked off the discussion by presenting general aspects of virtual conferences (and climate change). The abstract of her talk was as follows:

“For the past 40 years, research communities have embraced a culture that relies on physical meetings of people from around the world: we present our most important work in conferences, we meet our peers in conferences, and we even make life-long friends in conferences. Also at the same time, a broad scientific consensus has emerged that warns that human emissions of greenhouse gases are warming the earth. For many of us, travel to conferences may be a substantial or even dominant part of our individual contribution to climate change. A single round-trip flight from Los Angeles (LA) to Frankfurt emits the equivalent of about 3.3 tons of carbon dioxide (CO₂e) per passenger, which is a significant fraction of the total yearly emissions for an average resident of the US or Europe. Moreover, these emissions have no near-term technological fix, since jet fuel is difficult to replace with renewable energy sources. In this talk, I first raise awareness of the conundrum we are in by relying so heavily in air travel for our work. I will present some of the possible solutions that go from adopting small, incremental changes to radical ones. The talk focuses on one of the radical alternatives: virtual conferences. A year and a half of pandemic has given us a fast introduction to virtual conferences, with mixed results. I am part of a community that has been organizing an annual conference in a virtual environment for many years. Virtual conferences present many interesting challenges, some of them technological in nature, others that go beyond technology. Creating truly immersive conference experiences that make us feel “there” requires attention to personal and social experiences. Those experiences need to be recreated from the ground up in virtual spaces. But in that process, they can also be rethought to become experiences not possible in real life.”

4 Retrospective on Online Operation in 2020-2021


Participants were requested to bring one slide to provide their perspective on the topic and all slides were combined together into a block to gather input and for triggering discussions and identifying areas for breakout sessions.

Parallel Group Work

The afternoon sessions were used to discuss certain topics in more depth in smaller groups. This section summarises the discussions of each group.

4.1 Guidelines (Best Practices) for Online Conferences

Srinivasan Keshav (University of Cambridge, GB), Franziska Lichtblau (MPI für Informatik – Saarbrücken, DE), Andrew Hines (University College Dublin, IE), Henning Schulzrinne (Columbia University – New York, US), Michael Menth (Universität Tübingen, DE)

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The breakout came up with guidelines for both traditional parts of the conference and social aspects (structured chaos) as described below.

To begin with, we felt that online conferences are different from in-person conferences. As such, it is not a goal that conference participants have an experience as close to a physical conference as possible. Instead, conference participants should be able to learn of new work in their areas of interest, meet with other participants in semi-structured interactions, and be able to present their work both formally and informally to others. These goals should be achieved using tools and procedures that may differ from that used in traditional conferences, but should lead to the same outcomes. To this end, we need to accept that online conferences will never match every aspect of a physical conference, especially for face-to-face (small group and individual) meetings. However, in some areas, they may actually be better than physical meetings, for example, in widening participation. That said, at the moment, there is no silver bullet for online conferences. As such, we need to build on existing tools.

4.1.1 Scheduling

Online conferences require us to revisit the traditional conference schedule with 20-30 minute paper presentation slots and a single timezone. Deciding the schedule is one of the most critical decisions facing conference organizers. Further, the organizers should keep the agenda on time and communicate with participants if there are technical issues.

The goal should be for the conference schedule to provide an overall framework for all conference events. It should allow participants to meet the twin conference goals of learning and interaction. There are three main issues:

- *Multiple time zones:* With multiple time zones, no single participant will be present all the time. So, it is necessary to create structures that allow interaction across time zones. Think about how to maintain continuity for people who come in and out of the conference. Moreover, there may be only a limited number of hours when all participants are present. This time should be used wisely for plenary sessions such as keynote talks, or best papers.
- *Zoom fatigue:* Day-long programs don't work. It is necessary to compress schedules, with perhaps a four-hour limit for each day. We recommend that organizers reduce the number of papers presented, with only the best presented. The rest of the papers can be made into posters or videos that people could watch at their convenience. An alternative is to create a multi-track conference, which has its own challenges and is still online.
- *Limited ability to focus online:* 8-minute talks with Q/A seems to work well, especially with pre-recorded talks. The talks present only the problem statement/conclusion, with details in the paper. Not everyone has liked this approach lately though.

4.1.2 Navigation and signposting

The conference schedule should make it easy for participants to learn about and join or rejoin events. Currently, some program sites are overfilled with information, making it difficult to find papers or events. Signposting and a clearly structured landing page is necessary to avoid

this problem. It would be helpful to be able to jump to the breakout or session with one click. This will require deep linking, which is currently not possible with Zoom breakout rooms. We strongly recommend that the conference schedule explicitly shows participant-tailored time zones so that a participant in each timezone knows exactly where to go.

4.1.3 Poster sessions

Poster sessions can be challenging to hold online. In-person poster sessions allow one to quickly scan a lot of work, with the option to dive deep, or move past. The main issues are:

- *Social awkwardness*: Current solutions do not provide quick skimming and make it awkward to leave if the content is uninteresting.
- *Hard to navigate*: A mechanism is needed to find interesting posters or move across mixed mediums (for example from Zoom to Hubs – specialised spatial-metaphor tools.)

Recently, we have gained some **experience** with online poster events particularly using three different solutions. *Mozilla Hubs* for instance, allow for bi-modal feedback in poster sessions. With *Gather.town*, on the other hand, it is difficult to identify neighbors, i.e., the author or another person standing next to the poster. Finally, *Spatial.chat* lacked good audio quality and overall felt not fit for poster sessions. Some of the **suggestions** when using these tools are listed below:

- A quick skimming is important, since it allows a walk by for a quick yes/no decision. While everyone sees that the person walks in and out. There is a need to increase social ease by openly stating at the conference poster session that it is okay to leave a room.
- Poster sessions should use breakout rooms with one breakout per poster. People can “walk by” and reduce the number of people per session to allow for a more personal interaction with the poster presenter.
- Speed-dating style approaches maximize the use of time, with an excuse to move on. This establishes clear rules, helpful especially for younger community members. Some conferences have also followed a one minute madness approach with an opportunity to arrange longer times if necessary.

4.1.4 Structured chaos

One particularly challenging aspect online conferences struggle to replicate is social and hallway unstructured conversations. These have not been solved by current tools. The main issue here is how to get seed conversations going and also get the conversations to further develop at the conference. There are several motivations, for instance, to catch-up to people, strengthening existing bonds, making new introductions to interesting or important people, building the community and renewing existing relationships, identifying potential research partners, other opportunities and finally recruitment and job hunting.

Although we haven’t yet found a perfect solution for social interaction, there are some positive experiences; for instance, for short coffee breaks, dropping people into breakout rooms at random works well. We think there is a need to explicitly identify “social butterflies” who can actively promote social interaction and start off the conversations. This challenge mirrors quite a bit in experiences with online teaching; for example, breakout sessions for students in a class have similar problems. As such, there is a need to bring willing participants together, who want to interact, but also not too many or too few and there is a need to strike a balance. Some difficulties and suggestions to this end are listed below:

- How to decide who starts the conversations? A couple of examples of questions that can be used as conversations starters: “Tell me about your work” or “You use tool/technology X, what do you think of it” or “What have you been up to recently”
- How to ensure implicit social behaviour is made explicit? There is a need to assign people roles so that they do not feel awkward: Explicitly approach specific senior members of the community to steer the communication. At the same time, how to avoid toxic behavior and egotists? We need to make a careful selection of people for dedicated roles.
- How to facilitate cross-pollination? This needs to be explicit perhaps with a special newcomers meeting event, where there is a chance to meet old timers. To this end, how to strongly encourage senior members to participate (such as in SIGCOMM student dinners)? Social interaction can be promoted by assigned seating in physical meetings or by joining a table even if you know no one there, chiming in the conversation is okay. However, the issue of how to balance people in meetings (half known, half new) is still uncharted territory. How to (actively) bootstrap chaos? Perhaps this can be done using social enabler tools and senior community members.

4.1.5 Text channel

A text channel emerged as a good idea for coordinating Q&A and general discussions. Traditionally, the Q&A session at the end of a talk serves as a ‘community peer review’ tool. Questions provide additional context for the work or expose lacunae that the reviewers did not catch. However, such a session can be somewhat intimidating for shy presenters. A text channel-based Q&A session allows them to participate. It also allows author responses to be captured, unlike the situation in a typical physical conference. Some guidelines when using Slack or similar text channel are outlined below:

- Session chairs need to be strict in enforcing discipline in Slack to prevent discussions from wandering. It is helpful to have a moderator or scribe to capture the Q&A content and turn that into a report published later (with the consent of the relevant parties, who have veto power). It might even be possible for scribes to report on “bits and bytes from the previous day” as is done in RIPE meetings.
- The audience can be encouraged to make use of special markers such as @ to notify authors for pending questions. Authors should be told that questions on Slack should be answered within 24 hours. It is not a good idea to have a generic channel with too much chatter, so one does not know who has to answer. One Slack channel per session is better, though there is still a need to find questions for each paper. On the other hand, one Slack channel per paper has too much granularity, making it difficult to find which channel to attend.

An alternative to Slack is Slido, which allows questions to be posed and voted on, especially for large audiences. We suspect that Slido would be useful for hybrid conferences as well.


4.1.6 Audio, Video and Lighting issues

Audio for virtual events is better than real life for some people, since it allows lip-reading and individual adjustments of audio level. Nevertheless, despite the experience from 2020-2021, bad audio and video quality continues to be a problem. Audio issues are not only serious (‘I have no audio’), but more subtle, such as issues with noise, echoing, and audio level. Automated testing of audio intelligibility might help. Alternatively, conferences should provide test sessions for interactive sessions such as panels and keynotes. Meanwhile, testing video submissions in advance of the conference is a good idea, since there are still problems

such as videos that do not work either on Mac or Windows or require specialised tools. An open research topic would be to use automation to judge quality of submitted videos. Finally, lighting can be an issue, especially back-lighting, requiring participants to require prior guidance on how to avoid problematic lighting.

4.2 Financial, Diversity, & Timezone Implications of Online Events

Mirjam Kühne (RIPE – Amsterdam, NL), Jon Crowcroft (University of Cambridge, GB), Cristel Pelsser (University of Strasbourg, FR), Amr Rizk (Universität Duisburg-Essen, DE), Vaibhav Bajpai (TU München, DE)

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Costs for online events – There are several costs for online events, namely – meeting platform (such as Zoom, Meetecho, WebEx); although many groups or universities already have licenses, social platforms (such as Gather.town or SpatialChat); meeting give-aways (tokens and T-shirts); stenographers and real-life captions, and finally simultaneous translations, to name a few of the tangible costs.

Being transparent about costs is important – There are some costs for conferences that are hidden in the publication costs of research papers. Established researchers have begun to use free research channels, but the issue exists, because younger researchers have to publish in well-established venues (that charge fees) to build up their CV for instance. As such, financial and business models will have to change. Conferences (and professional societies) who rely on conference fees will have a problem. There are currently several revenue streams for events, (some of which are also used to cover other costs), namely conference registration fees, sponsorships, access to research papers and carbon offsetting whereby some parts could be used to cover costs of events. Organisers could also help to promote environmental projects (which is good for reputation of the event.)

Sponsorships – There seems to be a hesitancy in sponsoring online events by sponsorship organisations. However, visibility still serves a good motivator for sponsors. Meanwhile, other sponsorship benefits have to be found. Further, organisers need to think hard on how to facilitate one-on-one conversations for recruiters, sponsors and peering coordinators in online settings.

Travel funds – It was unclear why and whether would employers fund travel and conference attendance when there is already possibility to attend online for free. It is possible that new participants might experience problems getting funding in the future. To this end, organisations may need to rethink and re-purpose travel funds and scholarships for some.

Conference local hubs – Some large meeting venues (such as the IETF) are proposing to run local hubs in addition to being online. The associate costs for running such local hubs is presently unclear, however, such initiatives could also help people from low-income groups to eventually participate.

Diversity – Online conferences help improve diversity since they encourage participation from attendees who cannot afford travel. Further, online archiving helps broader access to the conference material. Some large venues (such as RIPE) offer stenography to help with inclusion. Meanwhile, smaller (local) events can also be run in local languages and to promote and strengthen local communities. Some venues are also offering child care for attendees to ease participation of parents.

Time zones – SIGCOMM 2020 and 2021 followed a model of pre-recorded presentations together with multiple Q&A sessions for different time zones. Meanwhile, the IETF follows a model of aligning to the timezone of the local venue. It is unclear which model is better or whether one community can easily adapt to the model of the other, since at some venues (such as the IETF) the focus is more on forming consensus and less on presentations. Collaboration that comes naturally with physical settings becomes tricky in online-only mode when participants join from different continents. One option is for conferences to span several weeks with shorter (say two hours per day) venue slots. The focus can also be shifted more towards online interim (topical) meetings rather than concentrating on one or two big events per year.

4.3 Lessons Learned from Online Everything (Group 1)

Georg Carle (TU München, DE), Alexander Raake (TU Ilmenau, DE), Oliver Hohlfeld (BTU Cottbus, DE), Colin Perkins (University of Glasgow, GB), Cristina Videira Lopes (University of California – Irvine, US), Jörg Ott (TU München, DE), Quentin De Coninck (University of Louvain, BE), Simone Ferlin (Ericsson – Stockholm, SE), Jürgen Schönwälder (Jacobs University Bremen, DE)

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Types of online meetings that we attended – The group has participated in a broad range of different online meetings. For one, Technical Program Committee (TPC) meetings where meetings for lower-tier venues were traditionally held online or via the phone, while top-tier venues had, by tradition, typically in-person TPC meetings that are now held online. Research visits to other research groups are another variation, where researchers known to a group made a visit while not being physically present at the remote location. This led to joining in-person group meetings and day-to-day discussions to be run largely online. Finally some experiences were gathered with conferences and workshops (virtual and hybrid) and with project meetings.

Experiences with online teaching– Since the COVID-19 pandemic forced universities to move all their teaching activities online, extensive experience with online teaching now exists. We highlight some of the experiences from the past year.

Firstly, online teaching generally can lead to multiple outcomes. First, better grades might be possible. Participants that take the exam are highly motivated while others drop out before and if videos are provided, they can be watched repeatedly. Yet, online teaching sets higher requirements when it comes to self-management and dedication, thus the dropout rate can be higher too (i.e., fewer students register for the exam) and consequently the number of participants can decline over time. Secondly, in a live lecture that is provided as video stream (not pre-recorded), it is usually hard to capture when participants get lost. This may happen in the beginning already (some approaches to catch this in text channels for Q&A, e.g., Slack, exist though). As such, having a dedicated channel for posting questions (e.g., Slack or Tweetback) – even anonymously – that are later sequentially addressed by the lecturer was perceived to work very well. This, however, requires further human resources such as a teaching assistant (TA) that handles the questions. It is hard for a lecturer to give the lecture and follow the chat simultaneously. Thirdly, if and when video recordings are offered, the lecture auditorium lacks sufficient physical presence as

before. Yet, many participants believe that asynchronous teaching material (e.g., videos) will be the future, e.g., explanations of an algorithm can be viewed multiple times, as mentioned before. The most difficult part in online courses are lab sessions, in particular if students need access to lab hardware. For all other cases, virtualization and remote access works well.

Technical Program Committee (TPC) meetings– TPC meetings for lower-tier venues were traditionally held online or via the phone. Top-tier venues had, by tradition typically in-person meetings that are now (during the pandemic) held online as well. In the past (pre-COVID-19 times), some venues organized physical TPC meetings. Meanwhile, TPC meetings are now often held online. They work very well when everyone is prepared for the meeting. However, if there is no travel, researchers tend to over-commit with meetings, but like with other meetings, TPC-meetings are usually hard to squeeze into overall schedule. This is simply a matter of habit, not an issue with online meetings per se. With online TPC meetings, what has worked well is handling conflicts of interest. At an in-person TPC meeting, conflicts need to leave the room (i.e., every few minutes TPC members leave and re-enter the room). In an online environment, conflicts can be sent to a breakout room and easily moved back, which smooths the process. Meanwhile, accessibility of online meetings has (and should be) increased also since no financial participation is required for travel.

Project Meetings – Two categories of project meetings exist: *Administrative* meeting such as general assembly or EU project review meetings in Brussels. Having these meetings online has not made things worse. The second kind of meetings are the *preparatory* meetings to get the project going such as to get teams to start working together, doing content-related work, build community within a given project (no social activities, but still due to different types of contacts). To this end, what helps is the social need that participants have to move things forward, although such interactions are very people-dependent.

4.4 Lessons learned from Online Everything (Group 2)

Colin Perkins (University of Glasgow, GB), Georg Carle (TU München, DE), Cristina Videira Lopes (University of California – Irvine, US), Oliver Hohlfeld (BTU Cottbus, DE), Jörg Ott (TU München, DE)

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What did not work well online – Online PhD defenses are sad. They function but lack the celebration aspect which makes it a very unpleasant experience for the candidate.

When it comes to teaching, recording online lectures is a huge time sink. Teaching also feels as if it is performed into the void with no received reactions as to whether the presented content is being understood or whether listeners are falling asleep.

Online meetings on the other hand face their own issues. They can generate churn as participants join and leave. Participants might also leave the computer and stay connected making it hard to identify who is present. There is also a tendency for people to over-do/commit the number of online meetings they attend. Too many meetings also lead to fragmentation and eventual loss of context. Coupled to that, without proper calendar invites, finding meeting information (links, passwords, ...) in emails can sometimes also

become tricky. Time-zones further complicate scheduling and limit available meeting options. Generally, it is also hard to quantify “missed opportunities”, but it seems attempts to simulate the in-person experience usually never works.

Current online tools also provide no way to capture social cues. For instance, when it would be okay to interact with participants and when not (e.g., when they are paying attention and are not open to talk). This is very easy in an in-person setting and currently impossible in a virtual format. During in-person meetings, one typically talks to their neighbours, while in online meetings, everyone is a neighbour. As such, the question is whom should you talk to? There currently also exists platform bloat – too many platforms (Where do we meet?, What is a shared platform that everyone has installed?) – When scheduling meetings, this information needs to be captured along with the available times to meet. Scheduling a meeting just becomes a bit harder. There is also no subconscious signal as to what platform needs your attention – one needs to actively check them. It remains unclear whether this increases the cognitive load.

When it comes to social activities, “forced fun-on-demand” is hard. Social activities work if they are prepared, e.g., a birthday party where wine is shipped to everyone or conferences where the ingredients for the social (e.g., mixology at IEEE QoMEX) are made available to the participant before. This is, however, very participant dependent.

What worked well online – Technical Program Committee (TPC) meetings seem to work well in general when held online and can be handled very efficiently. For example, when handling conflicts of interest as discussed before. Group work works well too by using random assignments to breakout rooms. In this mode, participants are assigned to smaller groups (e.g., up to 4 people) at random by using breakout rooms. There are two examples. First, (panel) discussions in smaller groups (e.g., IEEE QoMEX 2021) and Dagstuhl style group discussions. Secondly, getting to know new people by randomly assigning conference participants to smaller breakout rooms works well, some online venues have used this mode for their social activities. Project meetings work just fine, since people know each other. Maybe more productive online than in-person since discussions are more focused with fewer disruptions. The downside here is that people tend to meet too often or schedule too many meetings. Interactive discussion with speakers during talks also work well, but may lead to burnout if they run for too long. Stopping by a conference for just a single session is possible online since no travel is needed. This is a real benefit of virtual conferences. Meanwhile, pre-recorded presentations become part of the proceedings and are although (mostly not as permanently) archived just like papers. This is a real benefit for the scientific community. Q&A discussions work better in online mode, too – more questions are being asked by junior people; the hypothesis is that online is less intimidating than standing in front of a mic. Shared editing of reports is also possible; in an in-person meeting, it is typically considered a bad habit to use a laptop during the meeting, so online note taking is less common. In an online meeting, the notes are just a window next to the video conference. Online mode also opens new meeting opportunities since it is very cheap (also time wise) to interact with new communities that one normally would not attend. Online birthday parties can also work – for example by ordering a bottle of wine or pizza to each participant – same wine and food for everyone creates a joint experience. Playing online interactive games (e.g., escape room) can also provide an immersive real-world experience.

Work life balance and health in general is challenged by online meetings – All participants considered that online meetings *can* challenge work life balance more easily. Preparing digital teaching material and online teaching in general takes much longer

(some participants reported up to ten times as long) as in-classroom teaching. In general, all participants reported that their work became more intensive since more meetings are being scheduled. This is, for example, reflected in the typical gap between meetings: the gap between in-person meetings is five minutes, between online meetings five seconds as many meetings start and end on the hour. Consequently, this more intense schedule can lead to health issues since people move less, e.g., don't leave their chair for ten hours.

What did we learn? – Unstructured activities do not work well online, e.g., random encounters during coffee breaks at conferences. Also creative parts of in-person meetings, e.g., during ITU meetings with side discussions, do not work well in the online world. However, structured activities work very well online. For example, online meetings are more focused with less distractions and are thus very time efficient. On the other hand, less distractions also means no unstructured activities such as no random encounters after a project review, PhD defence or a TPC meeting. A general question concerns how to lower friction? Lower friction activities happen easily online, while higher friction activities get missed. Friction can also be increased artificially. One can consider fetching and sending emails only once per day. This increases the minimum RTT of email noticeable to others and thereby helps to focus on getting work done.

In general, different meetings have different requirements. If online meetings are successful mainly depends on these requirements. Certain meetings do achieve their goal if the agenda is fulfilled, and thus can work very well online. Other meetings have important goals beyond the specific agenda: can be challenging online.

Main takeaways – Different types of meetings have different requirements and audiences. As such it is important to be goal-oriented – structured activities work well online, when the tools meet the needs of the meeting. Meanwhile, unstructured activities (whiteboard-style idea creation, random encounters) do not work well (e.g., what happens after a PhD defense). Online meetings are more focused, have fewer distractions (examples: panels, PhD defenses) but lack the overall social cues.

5 Guidelines for Designing Hybrid Conferences

Participants were requested to bring one slide to provide their perspective on the topic. These slides were combined to trigger discussions and identify areas for breakout sessions.

Defining Hybrid Conferences: A Terminology

Henning Schulzrinne proposed the following terminology for hybrid conferences that the group agreed to adopt in its further discussions:

1. **Passive (inactive) Hybrid** – This model allows only passive remote participation by making videos of talks, demos, panels available to both local and remote attendees. The material can be recorded ahead in time. In this model, decent Internet connectivity is necessary to remotely access the material and therefore could be an issue in regions that censor the Internet in different ways.
2. **Semi-passive (semi-active) Hybrid** – This model supports a limited degree of remote participation including questions, thereby running in a “webinar” mode of operation. The prerequisites are requirements for (1) plus decent audio equipment for interactive

presentations. In this model, capturing local audio could become an issue. The model also risks trolling behaviour from anonymous remote participants during the Q&A. As such, lightweight training is needed for session chairs to handle such cases. Yet another issue is how to implement turn-taking with such a mix of (online/presence) participants. A possibility of professional stenography for speakers can help with written material.

3. **True (fully active) Hybrid** – In this model, both presenters and audience can be either local and remote. The IETF has had experience with such a model, whereby virtual queuing was implemented using QR codes, but it was found that such schemes also break flow. Eavesdropping in online mode is an issue. For small side meetings, traditional Skype also works. It is unclear how to implement two levels of social interactions – one for each mode of participation and whether it would work at all. Yet another concern is how mentoring (and matchmaking of senior academics to students) would work.
4. **Distributed Hybrid** – In this model regional in-person clusters or hubs are created with a shared program and viewing parties. In such a mode, travelling to local hubs has a carbon cost but it is to be explored whether the experience is closer to attending a traditional in-person conference. The Chaos Computer Club (CCC) has been running local hubs for a while, but the experience has not been too positive. On the other hand, running multi-site conferences have the risk of ending up with a multi-conference experience. As such, local hubs still have the advantage of socialising with people at a smaller scale at a much more personal level due to localised nature of languages as well.

Parallel Group Work

The afternoon sessions were used to discuss some selected topics in more depth in smaller groups. This section summarises the discussions of each group.

5.1 Technical and Social Barriers to Hybrid Conferences

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Technical barriers – At the moment, the tools themselves appear to be technical barriers. Some of the challenges with current tools include remote and in-presence queue management, ability to see all remote participants at once, or conversely cannot fully see the physical room when remote. Reading the chat and speaking at the same time is a hurdle. Similarly using *Gather.town* for hybrid events presents its own challenges such as how to search for specific people and whether technologies such as “find my ...” or a “tile” attached to conference badges are needed. Such technologies also open privacy concerns and the willingness for attendees to use them. It also opens up challenges on how to synchronise the avatar of an in-person participant as they move physically in the real-world and whether such avatars really work unless they are made fully immersive since latency is also a barrier to immersive interaction.

In terms of equipment – the IETF has used whiteboards before. Meanwhile, online teaching has recently used projections of physical whiteboards during the pandemic times. However, the overall question still is whether we need to adapt to a virtual world? (or) make the virtual world better to mimic the physical world?

Social Barriers – Experience has shown that sustaining creativity in online-only modes has been difficult to achieve. The question is whether we can sustain creativity in hybrid modes? Maybe a new technical environment (using a phone instead of a laptop) is needed to implement social meetings? Large physical coffee breaks usually create the possibility to talk in small groups, but this is really hard to imagine implementing in large Zoom coffee breaks. Artificial background noises (e.g., rain) may help to create some sense of the physical environment, but the problem largely remains unsolved.

5.2 Requirements for Hybrid Conferences (Group 1)

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It is assumed that all hybrid events will have a structured and an unstructured component, whereby the social interaction could happen in smaller groups on local hubs. The group focused on the universal requirements for any hybrid conference:

Platforms and technology – One key aspect is good audio. The question here is how to capture good audio from the in-person participants and how to ensure remote participants can clearly be heard. The ability to quickly isolate points of failure and assign responsibility to quickly be able to fix them. The general accessibility of such audio material is also key (via audio transcripts for instance). Further, meeting applications need to be made better to facilitate hybrid conversations together with a usable remote platform to ease participation with in-presence attendees.

Human processes – A successful hybrid event requires session chairs to be effective. This requires management of interactions and on-boarding. Expectation management is also key to this end, whereby fairness needs to be defined as to how events will prioritise the experience of in-person attendees relative to remote participants. Being transparent about privacy and security decisions is also necessary.

Planning – The key question here is the ability to manage the uncertainty of meeting logistics – how many participants attend in-person versus remote since this ratio has direct consequence on the registration fees and is an issue for the organising team.

Integration – What systems need to be put in place to make a smoother integration of remote and in-person attendees? How to organise community introductions and on-boarding? How to ensure long-term mentor-ships (beyond the conference) needed for inclusion of community members are made possible. Would a parallel track or a programme to integrate new people into the community help?

Unexpected Consequences – The last aspect is how to deal with financial models (for organisers and for professional societies) that rely on in person conference registration as a revenue stream and still remains an unresolved challenge.

5.3 Requirements for Hybrid Conferences (Group 2)

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In this group, we took a more classification approach to the topic of hybrid conferences. Firstly, we outlined the actors and the technology requirements. Then, we looked at the organisational and interaction effects, moving on to the impact of scale. Finally, we discussed non-technical aspects such as legal and privacy considerations and mapping these considerations on to the five different types of hybrid events, identified earlier in the meeting.

Actors and objects of meetings – Participants can appear as real persons, or be represented by transducers (e.g., local robots), or proxies (e.g., other local participants). They may be rendered via room-attached screen(s)/loudspeaker(s), or even as holographic representations. A participant’s actions may appear as real signals from participants, or be mediated through symbolic or other representations that are perhaps technology-mediated. Meanwhile, room(s) can be meeting room(s) or connectives, such as corridors or hallway(s).

Technology components – Effort in setting up hybrid meetings varies widely depending on the level of attempt to achieve fidelity or to provide some valid meeting experience. High-effort approaches may include feature-rich systems, with personal proxies of remote participants, or local video-robots as technical proxies of remote participants. Low-effort might involve laptops to allow local participants in hubs to see and hear others in other hubs.

Technology components include considerations of the variation in hardware and software requirements for local and remote participants, and whether these provide interoperability, e.g., via web-based approaches (e.g., WebRTC). Similarly, low level baseline technical support might be required at all ends, such as YouTube integration

On the media side, most experts agree the primary consideration is audio, and factors include intelligibility, quality, localization, spatialization; echo-cancellation, amongst others. Video quality and localization matter, but A/V sync (time, space) less so. Latency considerations show up when a meeting needs to have more or less interactive and symmetric versus asymmetric delay depends on the meeting organisation (free form or chaired.)

Connectivity also strongly depends on the physical room characteristics, acoustics and lighting setup, with poor room acoustics often contributing to a bad experience, however much effort is put into better microphones and software. Complementary tools such as chat, white board, document camera (physical whiteboard) are useful (also used as meta tools to navigate multiple sessions). Similarly, collaboration tools not integrated into the conferencing applications (such as Google Docs), support the collaboration in the event of poor audio.

Meeting organization – The organization of the meeting is also very important when choosing tools and technology. So gatekeeper roles and mechanisms such as meeting access management, registration fees and other financial considerations, matter. During a meeting, specific individuals acting as moderator(s), or directors (perhaps somewhat like TV/movie directors) of meeting can really help too, for example, choosing the currently

relevant video and audio to be remotely presented; this can also be partly done by a tool (e.g., speaker tracking). The general structure of the event, once running, matters as well. Considerations of human processes and meeting behavior, expectation management, including indications about privacy and security-related matters of meetings and timings are very important. Meetings across multiple time zones, and the impact on individual or multiple, distributed group locations matter a great deal in terms of fatigue, meals and sleep.

Interaction-related effects – There are a number of navigation like activities that are needed if we want the whole event experience of a hybrid meeting to be anything like real life. Some of these matter a great deal more than was realized before we started depending on online meetings. For example establishing ad-hoc communication channels, finding and navigation, groups, individuals; setting up hallway discussions, perhaps through virtual break out assignments – are increasingly valued.

During ongoing encounters, using established communication channels to manage activity and interactivity (e.g., of conversations, participants) all needs – continuity over long periods, including keeping in touch between participants, the need for session control (by a human or by technology) for groups of individuals that have latencies beyond when human conversational group communication paradigms work and of course, support for decision-making tools (voting or IETF hum tools). Collaboration between participants (shared document, shared screen or shared code) also is important that requires integration between tools, and at the very least through (possibly managed) screen and URL sharing.

Larger-scale impact and effects – As events scale up beyond small meetings or workshops, the challenges increase for managing meeting effectiveness and efficiency. Meeting fatigue, jet lag, multitasking, all start to take a toll on participants, and therefore on the overall group. Fatigue is possibly contributed to by the reduction in non-verbal communication. New encounters and meetings in hallways are starting to be supported by virtual reality (VR) environments, and meeting formats are evolving to take advantage of this emerging technological support.

Legal, security and privacy aspects – Meetings need to continue to be recorded, despite technological advances. Handling of sensitive material, pre-meeting, during meeting, post-meeting (e.g., deleting files afterwards) needs to be thought through. Indication of accessibility are a legal requirement in many countries. Implications depend on whether political or private topics may be discussed and should be made clear as part of the pre-meeting management, as should concerns about possible metadata collection by third-party vendors.

Hybrid meeting considerations – We considered this thought experiment: Imagine these extreme points of virtual versus physical co-location of participants: multiple 2-pairs local (total N), all combined virtually versus two large rooms with $N/2$ participants, with virtual connection between two rooms. Now the question is how to measure the attention of participants, (e.g., eye tracking of the participants) and determine the relative value of virtual versus physical human communication protocols. Perhaps a small research program could be based on this. From the QoE perspective, influencing factors include human and technology as previously discussed: Audio (intelligibility, quality, localization); video (quality, localization), A/V sync (time, spatial), delay (symmetric vs. asymmetric), connectivity, physical room characteristics (real vs. virtual), acoustics and lighting setups.

5.3.1 Mapping the requirements to the Hybrid terminology

We now map the requirements to the four kinds of hybrid meetings identified previously based on the discussions in the breakout.

Passive (inactive) hybrid – The goal here is to make video of talks, demos, panels available to all “attendees”. This requires no actions from the participants perspective (actors) and objects of meeting are basically depictions of online material. In terms of effort this is low-key and involves low technological involvement too. Meeting organization is easy, with minimal moderation, and not constrained by time-zones. Although interaction-related effects are minimal with no encounters at all leading to no collaboration. As such in terms of impact and effects, it leads to one-way dissemination and minimal feedback. Further, the legal, security and privacy aspects only need to be checked in advance.


Semi-passive (semi-active) hybrid – The goal here is to enable participation (including questions and presentations) by audience, but not full functionality. This involves getting used to the tools (e.g., Discord, Slack) that enable such inclusivity. In terms of technology, the requirements involve all of passive hybrid (see above) plus a possibility to invoke textual chat functionality when needed.

True (fully active) hybrid – The goal here is for presenters and audience to be both local and remote with full ability to participate in all activities such as hallway discussions and others. This mode requires high-quality interaction for all situations and the ability to perceive audience reactions. As such, a well-working system is needed for participating in irregular hallway discussions, and allowing attending individual conversations in a larger gathering (aka “cocktail party effect”).

Distributed hybrid – The goal here is to recreate regional in-person clusters, with a shared program and viewing parties. In terms of technology, this most importantly requires keeping interactivity between participants.

5.4 Financial, Diversity, and Timezone Implications for Hybrid Events

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We discussed some implications of hybrid conferences in this session.

5.4.1 Why hybrid conferences could be more attractive

Compared to purely online conferences, semi-passive and fully active hybrid conferences allow for physical presence. Physical presence at conferences is valuable from the perspective of multiple sectors. Participants from industry can meet potential employees and learn of advances in the field. Participants from academia find physical presence critical for high-bandwidth learning and networking and recruiting students (or faculty). Participants from government sector (especially funders such as the NSF) also find physical presence important to learn about the field and where additional economical incentives are needed. Physical presence also leads to multiple positive outcomes, for instance:

- *Face-to-face interaction*: Smaller gatherings allow participants to get a sense of which topics the research community is collectively moving towards.
- *Recruiting*: It is common for employers to send employees to recruit graduating doctoral students at conferences. This is typical for industry that especially run dedicated job fairs at conferences to this end.
- *Forcing attendees to block off time*, with the benefit of getting energized by change of location and refreshed at a conference by change of the environment.
- *“Reward” vacation*: Travel to an attractive venue is a reward (especially for the student authors) for a paper being accepted and all the hard work it entails!

For these reasons, hybrid conferences, which allow physical presence, are preferred to purely online conferences. However, the group noted in passing that the group was not convinced that collaborations materialize from interactions at large conferences, since most collaborations are between students and faculty on the same campus or regional meetings and visits.

Hybrid conferences are important from a financial perspective, as well. Professional societies (such as ACM and IEEE) are being hit with three simultaneous financial shocks: a loss of funds due to open access publishing, decline in membership, and declining conference revenues due to the move to online conference. Thus, they have an incentive to boost revenues using physical conferences, which brings in more revenue than online conferences. This will make them more supportive of hybrid conferences over purely online conferences. Although, the financial shocks are hitting not just the professional societies, but other organisations too (e.g., IETF) since the costs scale in complex ways. Meanwhile, hybrid conferences are also more attractive for sponsors, compared to purely online conferences. Finally, researchers, both faculty and students also can typically access travel funds to travel to hybrid conferences. So, for these financial reasons, it is expected that hybrid conferences would become more common in the future.

5.4.2 Diversity

Diversity has different dimensions, such as differences in geographical regions, under-represented minorities (such as women in computer science), disadvantaged people such as those with disabilities, or being financially constrained. At a high level, hybrid conferences have the potential to increase diversity, and in fact, the measures chosen by hybrid conferences should percolate to physical conferences as well.

We now discuss why we believe this to be the case, as well as specific best practices. To begin with, we advocate moving the location of the conference around the world in consecutive editions, to be more inclusive to different geographies. Most major conferences do this already. However, we need to caution that not all tools work in all geographies – e.g., the ecosystem of Google tools in China. Second, hybrid conferences can be more inclusive using new technology. For instance, hybrid conferences (and online as well) can be more inclusive in terms of different language groups. It is now possible to provide simultaneous translation for non-native English speakers. Other ways where hybrid conferences are more inclusive than physical conferences include video recordings, especially with *automatic captions*, have helped non-native speakers. *Text-to-speech* to do the presentations automatically, where the non-native English presenters simply write the script. This is not necessarily a purely positive outcome! Of course, it has always been possible to hire someone to speak (or record) on your behalf, do the slides (or video) productions, with appropriate disclosures. Finally, accessibility options for various impairments – screen-readers, other accessibility options, speech-to-text translations. It may be also be possible to hire remote video interpreters for

sign language (i.e., not at the main venue but at each local site for a multi-site hybrid.) This is not cheap but then there is no need to pay for travel and multiple interpreters can be used to load balance this effect.

Hybrid events have the potential to increase inclusion but new issues may arise, leading to new dangers. For instance, hybrid conferences will create **first- and second-class attendees**. For example, some faculty may restrict junior students to the remote option. **Funding for the physical portion** of the conference may be more difficult to obtain. Corporate sponsors used to fund student travel. The question is whether they will continue to do so in the hybrid world. Industry may fund students to attend in person, primarily from a recruiting point of view, but only if students are also physically present. As such, there will be need to find new ways to use sponsorship money in the hybrid world. Hybrid events may generate **social pressures to not attend** conferences – e.g., women with young children being pressured by family to not go. For example, more women left the workforce than men during the COVID-19 crisis. Providing childcare at the venue will mitigate this effect. However, it can be difficult to find on-site childcare even for hybrid conferences, especially for services that may need to be provided outside the normal work day. Finally, some folks may have access to better video production resources. As such, there may be a need to transfer travel money to video production costs. Of course, many universities already have video recording studios for remote teaching. These could be made available to graduate students for conference presentations, for instance.

5.4.3 Timezones

It is impossible to avoid the inherent problems that arise from attendees participating from multiple timezones. Attendees of hybrid conferences will need to realize that their experience will never be as good an experience at a fully physical conference. Nevertheless, there is a need to use a combination of strategies to make the experience as good as possible. We now discuss some potential strategies. To begin with, both local and remote attendees will need to show some flexibility to allow the program to spill outside the “normal” workday, potentially answering questions on their work in the middle of the night. In any case, with time-zones, it is critical that there be both synchronous and asynchronous modes of communication and interaction. For attendees who cannot attend some part of the conference, they will need a way to catch up to the event and its content.

Perhaps the only way to deal with time-zones properly is to opt for a multi-location hybrid with no single conference venue. Physical participants at one location would interact virtually and asynchronously with participants at other locations. We could have a 24 hour program or replication of events – perhaps 14-16 hour striped event, as with SIGCOMM 2020. An extreme version would be to have multiple physical conferences that are somewhat independent and translate from each other, if they are run in different local languages. Each version could have different live and recorded content! In this approach, national entities organize events (e.g., COMSNETS, SIGCOMM, APNET) and the top x% translated to international venues, presented on behalf of the authors, creating a federated super conference. SIGGRAPH Asia/Europe/US are examples. For non-local conference editions, papers could be presented by proxies and questions answered live, for instance.

However, this strategy also cuts the community into segments. But this was the case in the past as well, when inter-region collaboration was hard. Local communities were the past and may be the future, as well, if COVID-19 evolves variants. Moreover, political barriers to collaboration also exist and are growing, and may preclude multi-national collaboration (besides the problem with funding international students, which is a problem already.) We

noted that many researchers from some countries (e.g., Japan and maybe Russia, and China in the future) mostly present in their own local forums and do not present at international venues. Perhaps the future is indeed local! If so, there will certainly be a loss of cross-cultural interactions.

To summarize, there is a feeling that multiple time zones in hybrid environments will continue to perpetuate split communities. The group felt that perhaps we are on the cusp of some change, with two simultaneous developments: a decrease in ease of travel and an increasing notion that world is splitting due to political processes. Perhaps we are re-entering a future that looks like that; with the past 50 years being a glorious anomaly!

5.5 Hybrid Everything: Colloquiums, Hackathons & Research Visits

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5.5.1 On deciding for an hybrid event

The question is not how to hybrid everything but for what meeting formats do we need to have an on-site component? There is a need to dissect the different activities at a meeting and design appropriate formats for them. A hybrid meeting is a meeting that you attend online and would have no access otherwise. You get to a hybrid meeting either from adding an on-site component to a fully virtual meeting or allowing remote participants in a usually on-site meeting. Since it is all about the meeting objectives, we discuss them next:

Meeting objectives – Different meetings have different objectives and thus require different hybrid levels. For instance, with IETF/RIPE meetings, the design goal is not to provide equal opportunities to local and remote participants. Such meetings can utilise certain access control mechanisms whereby certain decisions (elections) are specifically made in person at the meetings. On the other hand, teaching has different design goals, whereby local and remote participants must be treated the same. As such, one aspect to consider is what are the goals of the local and remote participants and whether they have same or different goals such as passive participation (listening to talks) versus active participation (meeting people).

Requirements for hybrid meetings – The participants need to be aware that it is a hybrid meeting, so as to adjust their expectation and behaviour. Firstly, the participants must be open and there should be willingness to interact with remote participants. Secondly, there must be a discipline as to make sure that everything that happens locally is remotely accessible, too. There might be instances, where private chats are not made accessible, such as conversations that happen during the in-person only parts of a hybrid event for instance. As such, expectation management is necessary to ensure everybody knows what happens when and who needs to be involved in what.

When is hybrid good (or bad) depends on participant motivation – For instance, with passive and semi-active participation, the goal is simply to listen in to talks and to interact with few people. As such, it is acceptable to not give equal privileges to everyone

and perhaps hybrid is a good alternative. On the other hand, if we want to include everyone (with same privileges) hybrid is difficult since senior academics attend a conference not for the talks but for interacting with others and/or strengthening social ties. Overall, the purpose of the event dictates the level of hybrid nature of the event.

5.5.2 Things to consider when organising hybrid events

There are different financial and technical implications of hybrid events. For instance, a passive hybrid event requires a dedicated video team. This incurs costs as to the video equipment and staff to handle the video and chat functionality during the event, but is largely affordable. On the other hand, “true hybrid” events are way more expensive and technically complex too (e.g., the SIGCHI remote robot experiment) and also do not scale up well to a large number of participants. Some more implications are outline below:

Financial risk for organizers – The question is why should a remote participant, one who is simply interested to sneak into the conference largely to get to know a new community have to pay equally. This poses a financial risk for the organisers since they do not know how many participants will register locally and remotely. As such, the entire business model (sponsoring, and attendance fees) depends on the format of the event whereby remote participants do not get to contribute in case of passive or semi-passive hybrid.

Timezones – The issue of time requires willingness and depends also on how often one needs to participate at odd times. For instance, participants from East Asia, USA and Europe are very challenging to add simultaneously to the remote event.

Lastly, when transitioning from on-site to hybrid, can consequently lead to the majority going online only. As such, it is important to lay out the target audience for whom the event is intended. For instance, as previously mentioned, in teaching, the trend is clear in the sense that online offerings results into very few or none on-site attendees.

5.5.3 Real-world Examples

Teaching – With online teaching, shared material (e.g., asynchronous video material) becomes very relevant. However, designing a hybrid course is hard. Physical teaching is much easier with slides and follow up questions. The key requirement with hybrid mode of teaching is to ensure that remote participants get to have the same experience as local ones. As such, good audio equipment is needed in the lecture halls. A traditional blackboard cannot be used any more – but a digital variant is needed that remains connected to the laptop and streams the content online while also projecting it locally. At the same time, context-switching to help both audiences is tricky where extra help might be necessary in the classroom. A flipped classroom is more fun for everyone (teacher and learners). However the problem is that the format is presently not generally accepted. On the other hand, people need to come on campus to interact and meet people. As such a mixture of both is needed whereby teaching should be online, while all other interactions should be on campus.

Remote IETF Experience – In general, networking (e.g., getting to know new people) was extremely hard in remote-only operation. As such, a hybrid setting may not be the right medium when the goal is to leverage the IETF meeting as an ongoing source to connect with industry. The remote registration is also rather expensive (although fee-waivers are possible without justification) and not proportional to the value that an (academic) gets out of a remote IETF meeting.

Conferences – The experience has been similar to that of remote teaching. The experience has been very positive when it comes to passively participating in other communities with low investment (e.g., meetings that are organised online now and would otherwise be only for a set of participants e.g., operators.). It also allows more equal opportunities to participate, albeit a bit difficult to implement in hybrid mode.

Hybrid meetings – Faculty meetings that were hybrid were horrible. It is not just about audio/video issues but more about the social cues. Perhaps brown bag lunch meetings could be the future since the meeting is online, the participation also goes up.

Project meetings – Online meetings are more structured. The main value comes from the notion that participants prepare ahead and most of the brainstorming goes into the preparation phase. Consequently, project meetings are better prepared, are inherently shorter and produce more output. In-person meetings on the other hand only help to create (or strengthen) social ties more strongly.

Geographically distributed companies – In this scenario, social ties are less relevant, but more important is to get the work done. Meanwhile, many companies already consist of geographically distributed teams. As such, the expectation to work together and get the work done is already in place.

Social ties – Social bonds are usually created out of joint experiences. They can either happen online or offline. For instance, to make online workshops more successful, they should be better at creating such joint experiences. Workshops are usually not as interactive as often people wish they would be. As such, having a good social event where the participants jointly do something is crucial.

5.5.4 Predictions for the future

It will be a gradual process to go online, whereby young people will be driving this change. All the small conferences will go entirely online or will just disappear. Meanwhile, all the big conferences will go hybrid – they have large enough communities that attend locally to survive. We might also see a world of regional events again that largely disappeared. On the academic side there will be a competition in the transition phase – some parts of the world will go in-person earlier, while others join in later. Distributed conferences might become a new way of organizing events. The downside here is the complexity of the organisation due to handling of finances. If we look at how distributed approaches in networking succeed or die out, it will be a question whether distributed conferences will succeed or not. An increasing number of people will chose not to travel to certain places of the world for political, environmental or economic reasons. Once the environmental issues become worse (and the climate models are correct), traveling will become expensive (due to increasing taxes on jet fuel), so increasingly fewer number of people will be able to travel. Consequently, funding agencies might stop affording it. As such, it is quite likely, the IETF will not have three big in-person meetings per year in ten years from now.

6 Conclusions and Next Steps

The goal of this seminar was to first review the current status quo of virtual conferences: what works, what doesn't, what needs improvement (theme of day 1). From this discussion, we discussed the requirements, implications, and guidelines for designing hybrid conferences (theme of day 2). It was generally believed that small venues will move entirely online and

others will be held as hybrid events in the future. Thus, design guidelines for hybrid events are needed. With this seminar we contributed guidelines for deciding when virtual or hybrid conferences are suitable and how to design them. The clear next step is to evaluate these guidelines in practice to provide data points for which designs work and which do not.

The discussions emerged from a group that was biased a bit by more senior colleagues. It is possible, digital natives might see this perspective very differently, since at the end of the day, the younger generation will be driving this effort.

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