HOUSE OF COMMONS
CHAMBRE DES COMMUNES
CANADA

THE AUDIO QUALITY OF HYBRID AND VIRTUAL PROCEEDINGS

Key Factors, Considerations and Recommendations

Submitted to the Standing Committee on Official Languages

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The Canadian context

The House of Commons has adapted to the challenges presented by the pandemic—and the physical distancing that the latter requires—in several ways. One of the most notable is the realization pursuant to orders adopted by the House of hybrid sittings and virtual committee meetings.

These new methods of conducting House business were preceded by extensive research and an in-depth analysis of the various simultaneous interpreting delivery products (SIDPs) available and an examination of the capacity to integrate the House of Commons' top-tier professional audio systems to deliver capabilities superior to those of any standalone videoconferencing system on the market.

In charting this new course, the health and safety of parliamentarians, parliamentary employees and our partners were—and remain—a key consideration.

Focused on enabling

Members' mobility, employees, participants and performance

In developing and implementing a technological solution to make remote participation in parliamentary deliberations possible, the House of Commons focused on five priorities:

1. Ensuring the mobility of Members
2. Allowing participants to contribute to democracy
3. Protecting the hearing of participants and interpreters
4. Enabling intelligible conversation to allow Parliament to do its work
5. Respecting parliamentary traditions and requirements, including respect for official languages

To this end, we conducted extensive market research and liaised with national and international partners. We consulted leading research institutions and more than 30 parliaments around the world, and worked closely with several parliaments that share similar requirements. We also worked with pre-eminent audio engineers and other experts in the field.

Protecting interpreters

As requested by both the Translation and the House of Commons Administration, independent testing conducted by a 3rd party of the National Research Council of Canada during live parliamentary events led to the conclusion that the House of Commons' custom-designed solution protects interpreters. Details of this testing can be found below. Also, in an appearance before the Standing Committee on February 16, 2021, the Translation Bureau pledged to provide the latter with the full report. The House of Commons' solution offers participants a safe experience, given:

- the technology available;
- the need to allow participants to contribute remotely;

- the constraints of a global pandemic;
- the need for equal access to audio services from hundreds of remote locations; and the operational imperative of ensuring the continuity of Parliament.

Addressing the challenges

Even with a solution that meets or exceeds international standards for the delivery of interpretation services, audio quality issues still sometimes arise during parliamentary activities.

Of the six key factors that have an impact on audio quality noted in the "Optimizing the sound chain" section below, poor Internet and intranet connectivity on the part of videoconference attendees is the most important and accounts for the vast majority of issues. Microphone equipment is the second most important factor, and computer CPU utilization comes in third.

That is why the House of Commons makes every effort to contact witnesses before their committee appearances to ensure that they are equipped with the proper tools and connectivity. Pre-tests are also done with Members. At the same time, the Speaker of the House of Commons routinely reminds Members of the importance of using House of Commons–authorized microphones during House proceedings.

The House of Commons also continues to work with local service providers in Members' ridings to ensure the best connectivity possible for Members in those locations.

Furthermore, as part of its commitment to continuous improvement, the House of Commons is investing in testing and analysis for improved microphones, Member listening stations and computing power.

Acknowledging the unknowns

The extent to which organizations around the world now rely on videoconferencing solutions to maintain business operability is unprecedented. Prior to March 2020, only 12.4% of Canadians worked remotely, but by March 31 of that same year, that number had risen to 35.5%.[1]

Significantly, the pace of technological adoption has surpassed Canadian and international research. The House of Commons anticipates that heightened global interest in scientific studies on telework tools will help more clearly define best practices and spur product development and evolution.

The exceptional nature of the House of Commons' solution (which includes health and safety protections and technologies specifically suited to the Canadian parliamentary context), however, makes comparisons and correlations with the solutions adopted by other organizations difficult.

Consequently, the House of Commons' ongoing and long-standing collaboration with the Translation Bureau is of particular importance. The Translation Bureau has jurisdiction over all human resource

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[1] Statistics Canada: Table 33-10-0228-01 Percentage of workforce teleworking or working remotely, and percentage of workforce able to carry out a majority of duties during the COVID-19 pandemic, by business characteristics.

matters relating to parliamentary interpreters, such as work hours, employee accommodations and professional training. Insofar as technological solutions can be refined or enhanced, the House also relies on the Bureau to share interpreters' feedback on the tools they use on the precinct. The House actively solicits comments from participants and support staff and gives serious consideration to any complaints or concerns raised.

Recommendation – adapting and improving

The House of Commons remains committed to its successful and long-standing partnership with the Translation Bureau and its personnel in finding solutions to improve audio quality. It is in that spirit that the House presents for the Standing Committee's consideration five elements that could help effect immediate and significant improvements:

1. Recommending the use of wired connections for parliamentary proceedings whenever possible.
2. Requiring all participants to use a House of Commons–authorized microphone.
3. Deploying new computers as required.
4. Working individually with participants to tune or improve their acoustic environment.
5. Making committee appearances by witnesses conditional on the completion of a pre-test.

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Optimizing the sound chain

Since the unanimous adoption on August 11, 1958, of a motion to approve the installation of a "simultaneous translation system" in the Chamber, the House of Commons has grown to be an internationally recognized leader in the provision of professional-grade audio systems.

The simultaneous translation solution, which began with the installation of rudimentary earpieces at each of the 275 seats on the Chamber floor and 625 seats in the galleries, is now a sophisticated system allowing for sound amplification, interpretation, broadcasting and transcription that optimizes the audio quality at every stage between speaker and interpreter.

Illustration 1: The sound chain of the House of Commons' in-Chamber solution

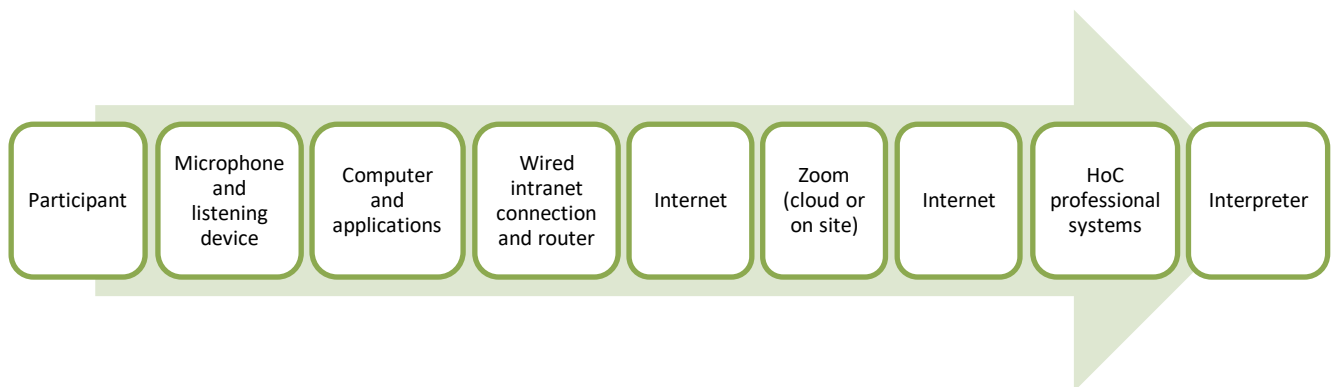| Participant | Microphone | HoC professional systems | Interpreter |

The complexity of mobility

These same high-quality interpretation, broadcasting and transcription systems used pre-pandemic are now at the core of the House of Commons' solution for virtual and hybrid proceedings, delivering a level of audio quality, sound protection and interpreter accommodation that no videoconference platform alone can offer.

This is what distinguishes the House of Commons' solution from videoconference solutions. Still, the House's solution is not without its challenges.

A sound chain comprising numerous participants in disparate (and sometimes remote) locations is inherently more complex than one where everyone is present in one specifically architected space.

Illustration 2: The sound chain of the House of Commons' hybrid solution

Participant	Microphone and listening device	Computer and applications	Wired intranet connection and router	Internet	Zoom (cloud or on site)	Internet	HoC professional systems	Interpreter

As the illustration above shows, six variables can impact the quality of the audio transmitted from participant to interpreter:

1. The participant's internal network (intranet), router and Internet connection;
2. The participant's microphone and listening device;
3. The participant's computer and applications (CPU utilization is critical);
4. The acoustic characteristics of the environment;
5. The videoconference platform (Zoom); and
6. The House of Commons' professional interpretation, broadcasting and transcription systems.

Participants' internal network, router (intranet) and Internet connection

The speed and latency of a participant's connection are the single biggest determinant of the quality of their audio output. Accordingly, the House of Commons will continue to assist Members with the deployment of wired connections from their computer to their router and upgrades for Members still experiencing connectivity issues. As new low-latency connection options become commercially available in 2021, the House of Commons will assess potential upgrades to support improved remote

connectivity. In addition, it is proposed that Members who choose to take part in virtual meetings from locations with poor acoustic qualities and poor connectivity be flagged to the meeting chair.

Microphone and listening devices

The quality of participants' audio-capture equipment has a demonstrable impact on the quality of their audio output. Accordingly, the House of Commons is investing in the testing and analysis of improved microphones and listening stations for Members. The focus of this testing and analysis is to create an audio environment similar to that which interpreters and participants are accustomed to on the Hill. The House of Commons is working in partnership with the Translation Bureau on this initiative and will formulate recommendations within the next two months.

Computers and applications

Virtual Parliament has led to new demands on the computer platform, and CPU performance is a key factor for audio quality. The House of Commons is testing and assessing the system capabilities of all participants to determine if higher-performing systems are needed to meet the requirements of the virtual Parliament.

Acoustic nature of the participant's environment

Facilities on Parliament Hill are the subject of considerable planning and investments to ensure that they meet expectations and requirements for parliamentary activities, which includes ensuring the high quality of room acoustics. Good acoustics combined with a good audio system leads to good speech intelligibility. This is why the House of Commons will invest in a program to work one-on-one with participants to tune or improve their acoustic environment. This effort will help improve audio quality for all participants. Due consideration should be giving when participants intervene from an environment with poor acoustics (e.g. car, boat, public space, outdoors).

Mitigation measures implemented

The House of Commons urges all participants to test the Internet connection they intend to use for a videoconference ahead of time. Committee clerks email witnesses to request an appointment. The email is followed by a telephone call from House staff to schedule tests to assess the technical equipment of each witness in the days leading up to their appearance, and immediate technical support is available to all participants from one hour before the proceedings until adjournment.

For those with problematic Internet connections, the pre-tests give the House of Commons' technical team the opportunity to recommend ways to improve connectivity or recommend a change in location. The House Administration assesses all situations individually to provide the best possible solutions and recommendations before an appearance.

Other connectivity options

Early on in the pandemic, the House of Commons assessed the feasibility of implementing a dedicated virtual private network (VPN) to deliver audio services for hybrid and virtual proceedings.

Such an approach has been used in the past for other initiatives, but was quickly ruled out for House sittings and committee meetings, as it could not ensure that:

- Members and witnesses could access the service from multiple locations (a requirement dictated by COVID restrictions); or that
- conversations among participants would be consistently and reliably intelligible.

The House of Commons continues to work with Internet service providers across the country and to research ways to improve participants' connectivity.

Videoconference platform

The House of Commons does not use Zoom for interpretation services. The House of Commons only uses the Zoom platform as the interface to transport the video and audio content to and from Parliament Hill, which integrates with existing professional-grade audio and video systems, including those used for interpretation.

While differences exist between videoconferencing platforms, these differences have very little impact on the overall audio quality experienced by participants and interpreters.

The House of Commons chose the Zoom videoconferencing platform for the following reasons:

1. It uses sophisticated compression algorithms (for audio processing) and performs extremely well at delivering good audio quality, especially from locations with low Internet bandwidth and high latency (or delay) (common in rural and remote Canadian communities).

2. It is secure. It meets the security requirements for known threat levels ranging from severe to substantial, as well as the required security response level for *in camera* meetings and other sensitive discussions.

3. It is scalable and can accommodate large numbers of participants at once, including the potential number for a Chamber sitting.

4. It is multilingual, enabling participants to select and change language options.

5. It is easy to use, with an intuitive interface for participants.

6. It is compatible with other systems used by the House of Commons, allowing for seamless integration with the following:

   o the interpretation systems and booths that provide interpreters with an appropriate environment in which to carry out their work safely and properly;

- o the broadcasting system that enables Canadians to follow the proceedings; and

- o the transcription system that supports the delivery of the official records of the House (e.g. Hansard).

The House of Commons' interpretation, broadcasting and transcription systems

The House of Commons' solution integrates top-quality interpretation systems (supported by professional audio technicians) at the end of the sound chain to isolate the videoconferencing platform from interpreters. By doing so, health and safety protections for interpreters are maintained, and the House of Commons' solution delivers consistently good audio quality and speech intelligibility.

More specifically, permanent and portable interpretation booths equipped with technologies that meet or exceed international standards enable interpreters to work much as they used to before the pandemic. Furthermore, the incorporation of technologies from leading global audio manufacturers (including Televic and Bosch) allows interpreters to change language channels much more quickly than in Zoom Advanced.

ISO-certified interpretation equipment

The House of Commons' solution for hybrid and virtual proceedings leverages the following interpretation environments and tools to ensure hearing protection for interpreters:

- **Simultaneous interpretation consoles**
  All consoles in the House of Commons' 17 committee rooms, two multipurpose rooms and parliamentary Chamber are ISO 20109:2016-compliant. ISO 20109:2016 identifies the requirements to protect interpreters' safety by eliminating the possibility of acoustic shock through the implementation of a noise-limiting technology.

- **Permanent interpretation booths**
  All permanent interpretation booths across the Parliamentary Precinct were installed in compliance with ISO 2603:2016, which specifies requirements for "building and renovating permanent booths for simultaneous interpreting in new and existing buildings."

- **Temporary interpretation booths**
  The House of Commons' two temporary interpretation booths, which were installed in committee rooms in April 2020 to protect the health and safety of interpreters by ensuring that physical distancing requirements could be maintained, were set up in accordance with the ISO 4304:2016 standard.

- **Specialized headsets for interpreters**
  Specialized ISO-certified headsets are provided to interpreters to protect their health and safety.

Third-party assessments of performance

International Association of Conference Interpreters: 2020 report

In its benchmark-setting report entitled *Evaluation of Simultaneous Interpreting Delivery Platforms for ISO Compliance – Second Round of Tests, October 2020*, the International Association of Conference Interpreters' Technical and Health Committee drew four critical conclusions about present-day Simultaneous Interpreting Delivery Platforms (SIDPs):

1. *With the exception of Zoom "standard mode", all tested systems met the requirements for latency, speech intelligibility and total harmonic distortion set out in ISO 20108, ISO 20109 and ISO PAS 24019 as measured during the test session.*

   The House of Commons continues to test and assess Zoom's high fidelity and advanced features that reduce audio processing. Opportunities may exist in the future to leverage some of these capabilities in order to improve audio quality or speech intelligibility. The House of Commons believes that audio processing presents only one of several possible opportunities for improved audio quality and is focused on the easiest and quickest opportunities, as previously described (e.g. improving the acoustic environment, improving microphones and listening devices, improving intranet and the reliability of interconnect connections, and improving compute resources). When some of these targeted improvements are addressed, the opportunity to leverage high fidelity may then be seized.

2. *The minimum speech intelligibility (speech intelligibility index, STI) of most of the platforms was in the "good" and not "excellent" range as per standard IEC 60268-16.*

   There are currently no SIDPs available on the market with excellent speech intelligibility similar to the level offered by the professional-grade systems implemented on Parliament Hill. The difference between "fair" and "good" on the speech intelligibility scale is important, but it is also very subtle. The House of Commons will continue to pursue all reasonable opportunities and assess the changes in the market over time on the delivery of SIDP improvements. The House of Commons does not currently believe that replacing Zoom with another SIDP will result in significant speech intelligibility gains when many other factors are still at play, as noted above.

3. *No hearing protection intervention by any platform in accordance with ISO 20109 (peak limitation and warning in case of long-time exposure to harmful sound pressure levels) was observed during the test session.*

   The House of Commons uses a professional-grade audio platform manufactured by market-leading suppliers to deliver the highest-quality hearing-protection service available.

4. *Although the impact of frequency-deficient, non-compliant sound on interpreters' understanding of the input audio signal and on their hearing will have to be studied in further tests, we have already received alarming reports about an increasing number of acoustic incidents and psychosomatic complaints from interpreters working with SIDPs, which according to prevalence studies and individual reports may be related to the specific sound quality interpreters are receiving through SIDPs, due to the audio processing of the platforms themselves and/or the use of non-compliant equipment in the sound chain.*

The House of Commons' pioneering solution integrates advanced, on-premises interpretation systems that maximize protections for interpreters, in adherence with the standards set by the world's foremost experts in acoustics and audio engineering.

As future studies are undertaken and manufacturers adapt products based on the findings, the House of Commons will continue to collaborate with the Translation Bureau to deploy the best solutions available that meet key stakeholder requirements.

National Research Council Canada testing

At the behest of the House Commons, National Research Council Canada (NRC) conducted a third-party test of the parliamentary solution, sampling two live events in committee rooms and one Chamber session as follows:

- July 21, 2020: West Block, WB035
- July 22, 2020: West Block, 218B-1 (Chamber)
- July 23, 2020: 180 Wellington, Room 415

During this sampling of live events, NRC observed that interpreters are not exposed to sound levels that could compromise their hearing in the long term. The recorded sound levels at the entry of the ear were steady and in the safe range (below 85 dBA), which is in compliance with the ISO standard for a full eight-hour work shift. Additional details can be found in Public Services and Procurement Canada's report, which should be provided at the request of the committee.

Good, striving to be better, but imperfect

In stating the above, the House of Commons in no way wishes to minimize or dismiss the claims of fatigue and strain that interpreters have shared with this committee. While the House of Commons has taken every precaution possible within the parameters of its authority to support the health and safety of interpreters and videoconference participants, the technical logs of hybrid and virtual parliamentary events indicate that audio quality challenges persist.

For this reason, it is of critical importance that the House of Commons continue to collaborate closely with the Translation Bureau to understand the needs of interpreters and explore ways to resolve any issues. The House welcomes the Translation Bureau's commitment to provide the Speaker with regular

reports of interpreters' feedback, and it is committed to dedicating the resources necessary to address any concerns about the House of Commons' work environment thoroughly and expediently.

Summary of recommendations

The following steps will be taken to improve the audio quality of hybrid and virtual parliamentary events:

1. **Intranet and Internet connectivity:**

   Participants will be asked to:
   - Join using a computer with a wired Internet connection when possible.
   - Connect with a quality, reliable, and low-latency Internet service. If colleagues tell participants on a regular basis that they cannot hear them well, this is one of the best indicators of connectivity issues.

2. **Microphones and Members' listening devices:**

   The House of Commons is investing in testing and analysis with respect to improved microphones and Member listening stations. This testing is focused on creating an audio environment that is similar to that which interpreters and Members are accustomed to. The House of Commons is working in partnership with the Translation Bureau on this testing and analysis and will develop recommendations within the next two months. In the meantime, the House will:
   - o Continue to promote the use of a House of Commons–authorized microphone.
   - o Encourage participants to flag device issues prior to the start of the meeting to the meeting chair. The Clerk will flag ongoing issues to Procedural Services and Digital Services and Real Property (DSRP) for resolution.

3. **Computing power:**

   Virtual Parliament has created new demands on the computer platform, and CPU performance is a determining factor in audio quality. The House of Commons is testing and assessing the system capabilities of all participants to determine if higher-performing systems are required in order to meet the requirements of virtual Parliament.

4. **Acoustic environment:**

The House of Commons is committed to working one on one with participants to tune or improve acoustics. This will help improve audio quality significantly for all participants in the meeting.
   o Consideration should be given to whether participants are given the floor if they are participating from an environment where the quality of the acoustics is insufficient. The Clerk will flag ongoing issues and work to resolve them in consultation with the Members and Whips.

5. **Next-generation SIDPs:**

The House of Commons will continue to work with the Translation Bureau and the world's leading audio-system manufacturers to assess offerings currently in development and to further improve the audio quality of the House of Commons solution.

6. **Process and participant improvements:**

- Consideration can be given to making witnesses' committee appearances conditional on the completion of a pre-test that identifies:

   o problematic Internet connections before parliamentary events so that, if issues cannot be resolved, participants can be encouraged to relocate to locations with better Internet connectivity; and

   o lack of proper audio devices so that remedial action can be taken before the meeting.

- The Committee will be notified of who has not passed the technical pre-testing so that it can be determined whether the individual should be precluded from joining the meeting.

- The Committee clerk will continue to ensure, to the extent possible, that applicable documents are delivered to interpreters several hours before parliamentary meetings (and hybrid House sittings, in particular).

- The Chair will continue to remind all participants of the need to speak slowly and be patient when participating in a virtual meeting, especially when the interpreter has difficultly hearing a participant due to unforeseen Internet and intranet connectivity issues.

Committed to improve

The House of Commons will continue to work with the Translation Bureau and the world's leading audio-system manufacturers to assess offerings currently in development and to further improve the audio quality of the House of Commons solution.

Indeed, the new technologies on the horizon hold much promise. Be assured that the House of Commons will do its utmost to ensure that interpreters, as well as Members and other participants, benefit from any advances as soon as their suitability for parliamentary proceedings is established.