# L&M U3A: Sound problems in meeting venues

Roger Kemp 3 November 2025

## Background

A regular complaint from members is that they have difficulty in hearing speakers in meetings. The files suggest this has been a recurring issue since at least 2015 and there were several examples cited at the Group Leaders' meeting on 31 October.

Looking round the AGM, it is apparent that many members of U3A use hearing aids. These are generally good at enabling the user to participate in conversation in a small group but are less effective in a large group or in a room with high levels of reverberation. More sophisticated (and more expensive) hearing aids – which could include a personalised frequency response, noise cancelling and stereo balancing – enable better hearing under difficult conditions, but not all members could (or would want to) purchase one. In any case, they may not solve the problem.

Two rooms we use have built-in assistive hearing systems:

- The **QMH Meeting Room** has a hearing loop and has had sound absorbing panels installed to reduce echoes, thus improving clarity. Members with hearing aids should be able to switch them to the "T" setting to receive the loop signal – assuming it's switched on.
- The **Dukes** has an infrared system installed in the Rake auditorium. This takes a microphone signal and transmits it in an optical beam. Attendees are issued with a loop that they put round their neck with an optical receiver dangling from it. This is, in effect, a personal hearing loop and members using the system should switch their hearing aids to the "T" position.

Anecdotal evidence suggests that neither of these systems works particularly well. How much this is due to the technology, and how much to members finding it difficult to select the "T" position on their hearing aids, or pointing the optical receiver away from the transmitter, or some other non-technical reason isn't clear.

## Technologies for permanently installed equipment

**Loop systems** (*Audio Frequency Induction Loop Systems*, or AFILS): This is the type of system installed in the Meeting Room of Lancaster QMH. The technology was first used in the 1930s. There is a microphone in middle of the room and an amplifier that produces an audio-frequency current in a loop of wire laid round the perimeter. Hearing aids switched to the T position detect this magnetic signal and use it in preference to their built-in microphone. Systems covering a limited area can be found at Lancaster station booking office, some Stagecoach

buses (so passengers buying tickets can hear what the driver is saying to them) and similar places.

The good points of AFILS are that it is common and thus generally well understood; most people with hearing aids will have come across it. The disadvantages are that it has to be installed in the room, so is linked to the building, not the users. AFILS is prone to electromagnetic interference as many modern electrical appliances, including LED bulbs and dimmer switches, also produce currents in the audio range, and the receiver cannot distinguish between wanted and unwanted signals. An interesting aspect is that the magnetic signal is not constrained to the intended room and can be received outside, which can be confusing. In the QMH, stronger signals from the Meeting Room loop are available in the corridor leading to the toilets than in the centre of the room.

AFILS systems work well when all speakers are reasonably close to, and facing the microphone(s) and where speakers take it in turns. They are less good in situations where, for example, the group leader talks for a few minutes and then says “discuss this with your neighbour” as listeners will need to switch their hearing aids back to normal to chat with the neighbour, and then back to T-position the next time the group leader speaks. As the switches are often small and inconveniently placed, this is unlikely to be a workable solution.

**Optical systems**: As used in the Dukes main auditorium. The presenter has a microphone which feeds an optical transmitter that transmits an infra-red beam to the people listening. Participants are given a “necklace” with an optical receiver dangling from it. This converts the optical signal into a low-power magnetic signal in the necklace loop, which is then picked-up by their hearing aids, set to the T-position. The main disadvantage is that the receiver has to be in *line-of-sight* with the transmitter – hold your copy of the agenda in front of the receiver and you cut off the sound. Plus it suffers from some of the problems of using loop systems described earlier.

## Portable equipment

**Amplifiers**: The easy alternative is the equivalent of the archetypical Englishman abroad: “If the natives can’t understand, speak louder”. Presenters are given a microphone and amplifier so their voice sounds louder. Amplifiers can be small and body-worn (photo on right)

suitable for leading small groups round outdoor archaeological sites or for gym instructors who do not have to compete with much background noise and where there is no requirement for different people to speak. Alternatively, they can be mains/battery-powered and on wheels, like the amplifiers used for U3A folk dance groups (photo on left) , which are adequate for rooms seating a few hundred people. (I’ve

used a similar unit in the Ashton Hall – an echoey building seating 600 – and it was not really good enough.)

Amplifiers are fine if the only problem is that the speakers are too quiet. However, often the problem is that there is too much background noise or there is too much reverberation or too many echoes.[1] An amplifier might help in some situations but would probably make reverberation worse.

**VHF radio**: Low-power radio links have many applications in a modern house: cordless telephones, central heating controls, doorbells, garage door openers, models, toys, etc. When used as an assistive hearing technology, the speaker has a transmitter which sends a signal to receivers held by individuals who need it. The output of the receiver can either be fed into headphones or into a personal loop that provides a feed to hearing aids set to the T-position, as described earlier. This is the same technology – and uses much the same equipment – as the tour-guide systems you see in some museums and art galleries, where a guide can talk discreetly to a large group without raising their voice and disturbing other visitors.

According to its suppliers, several U3A groups have bought portable VHF radio systems. The photo shows a digital tour guide system comprising 2 transmitters with headband microphones (for the presenters), 44 earphone receivers (for the audience) and a charger transport case.


I am not suggesting that we need anything this size but it is a technology that is scalable and it might solve some of our problems, as well as providing a possible resource for some outdoor groups.

**Bluetooth**: Most modern phones have Bluetooth, which is a UHF radio link. It can be used to connect to a hands-free car-phone and many other gadgets. Many modern hearing aids are fitted with Bluetooth.[2] The photo shows a pair from MobilityX [3] which cost about £200 – there are many more expensive brands. In a few years' time, it is likely that most hearing aids on the market will be equipped this way (but this doesn't mean that all U3A members will have ditched their existing devices!) These would allow speakers to use a mobile phone as a transmitter direct to listeners who need support, with minimal distortion or interference.

[1] See the appendix for an explanation of reverberation, etc.

[2] https://www.hearingaid.org.uk/hearing-aids/bluetooth

[3] https://mobilityx.co.uk/products/rechargeable-behind-the-ear-bte-hearing-aids-pair-both?variant=43559815151846

## Inclusivity

Some of the solutions require no action from group members. The venue owner could make improvements to the room (e.g. hanging sound absorbent curtains) or the group leader could bring in some equipment (e.g. an amplifier) and members just experience improved audibility. An inclusive solution.

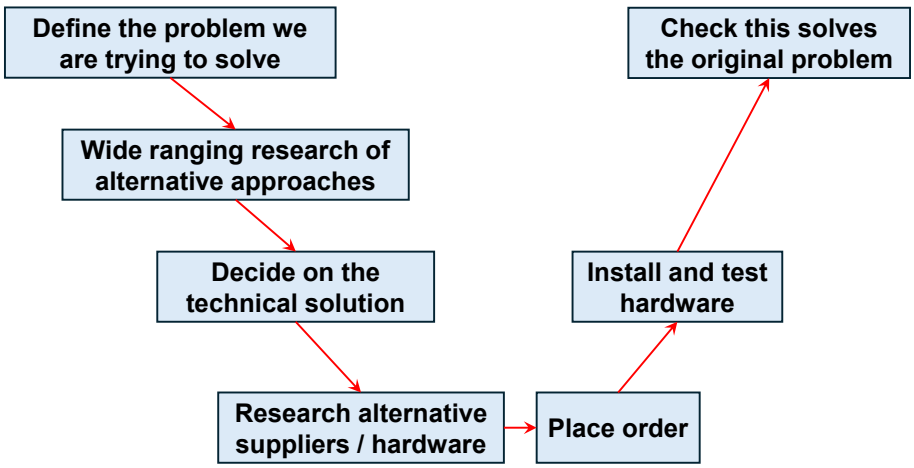
Other solutions rely on members adjusting equipment they already own – for example, switching hearing aids to the T-position at appropriate times – but do not place specific requirements on that equipment. Although this could be described as inclusive, it requires members to understand the principles behind the technology and thus when to make adjustments. It also requires them to have sufficient manual dexterity and visual acuity to click small switches, without becoming distracted from discussion in the group.

Then there are technical solutions that rely on members using specific brands of technology. For example, these might require members to have an iPhone, that uses unique technical standards. Only slightly less exclusive are solutions that, for example, require hearing aids to be Bluetooth-compatible, or assume that members have a smart phone and an earpiece and are prepared – and have the ability – to download particular apps to it.

When considering how to improve members' experiences, we must ensure that we are not excluding other members by the choice of technology.

## A way forward

If we are to make progress in providing technical support in situations where members find it difficult to hear, the first requirement is to understand the problem we are trying to solve. When addressing a systems engineering problem, there's a classic model called the V-curve.[4] I've reimagined it for the U3A:




[4] https://raeng.org.uk/media/o3cnzjvw/rae_systems_report.pdf

We need to find out ***what is the real problem we are trying to solve***. Is it a problem restricted to a particular room (such as the meeting room in the library which has terrible reverberation, resonance and echo issues), or particular groups (such as a dance group where the caller cannot be heard above the band), or particular speakers, or a few group members who can't hear whoever is speaking, while others can. Or half a dozen different problems in different groups and at different venues that all need different solutions?

Then it would be possible to look at all the alternatives. For some listeners, better lighting might help if lip-reading assists their comprehension. In some rooms, we might offer to help fund sound absorbing panels. Then let's look at what we have in the various cupboards to see if we can use existing equipment to resolve an issue. Finally, do we need to invest in new equipment – and, if so, what technology?

All that identifies what we are trying to do and what the problems are. These are the important issues.

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## Appendix – room characteristics

When considering how sound propagates from a speaker to a listener, there are four topics that could be included:

- ◊ reverberation time
- ◊ room resonance
- ◊ echoes
- ◊ critical distance

### *Reverberation time*

When you speak in a room, the sound bounces off walls, ceilings, floors, furniture and anything else in the room. Some hard surfaces reflect almost all the sound that hits them, others absorb most of it. How much is absorbed is measured by an absorption coefficient – 0 is completely reflected, 1 is completely absorbed.

If you stand under some canal bridges and clap your hands, you can hear the sound decaying. The same is true for rooms. The standard measurement is the time taken to fall to 1/1000 of its original value. (The scientific term is 60 dB, hence the abbreviation RT60, for reverberation time.) In practice, you can't usually hear a 60 dB drop as there is too much extraneous background noise, but that's the standard.

The ideal value of reverberation time depends on the use of a room. These are typical values. [5] In general, you expect lower values for smaller rooms.

- RT60 < 1 s: Good for classrooms.
- RT60 = 1 s: Good for speaking: articulation of speech is clear. Music doesn't sound full, rich, or warm at this level.
- RT60= 1.5 s to 2.5 s: A good compromise if the room is to be used for both speaking and music.
- RT60 = 3.5 s: Better for music, but some loss of articulation. Would likely be difficult to understand speech.
- RT60 = 8 s to 11 s: Large medieval cathedrals; well suited to organ music or unaccompanied voices, such as Gregorian chants.[6]

Room resonance is fairly easy to estimate. This is the calculation for the ground floor meeting room in the Library:

| **Surface** | **Material** | **Area** | **Absorb. Coefficient.** | | | **Total Absorption** | | |
|---|---|---|---|---|---|---|---|---|
| | | sq. m | 125Hz | 1kHz | 4kHz | 125Hz | 1kHz | 4kHz |
| Floor | Thin carpet solid floor | 50 | 0.10 | 0.15 | 0.30 | 5.00 | 7.50 | 15.00 |
| Ceiling | Plaster | 32 | 0.30 | 0.20 | 0.15 | 9.60 | 6.40 | 4.80 |
| Windows | Glass - three, each | 18 | 0.10 | 0.06 | 0.02 | 1.80 | 1.08 | 0.36 |
| Walls | Plastered brick | 90 | 0.02 | 0.03 | 0.05 | 1.80 | 2.70 | 4.50 |
| Tables | Wood tables | 6 | 0.25 | 0.05 | 0.02 | 1.50 | 0.30 | 0.12 |
| Air | per m3 | 150 m³ | 0 | 0.01 | 0.02 | 0.00 | 1.50 | 3.45 |
| Totals | | | | | | 19.70 | 19.48 | 28.23 |
| | **Reverb. time** | | | | | **1.22** | **1.23** | **0.85** |

When the QMH meeting room was refurbished with acoustic panels, the reverberation time was reduced from c. 2.5 seconds to about 1 second. This makes it easier to hear what people are saying.

### *Room resonance*

In the same way that the air in an organ pipe resonates at a particular frequency, the air in a room can have resonances. The frequency of the oboe A to which orchestras tune is 440 Hz (cycles per second), and the wavelength is 0.77 m[7] For a room like the Library meeting room, with two 3 m high parallel walls 5 m apart, the natural resonant frequency between these is 68 Hz (near the lowest note on a cello). There can also be resonances at 102, 136 and higher harmonics. It can be difficult to hear

[5] https://commercial-acoustics.com/guides/target-reverb-times/

[6] St Paul's Cathedral in London has been measured a

[7] The formula connecting wavelength and frequency is:

$$wavelength = \frac{speed\ of\ sound}{frequency}$$

| | | |
|---|---|---|
| Speed of sound | 340 | m/s |
| Frequency | 440 | Hz |
| Wavelength = 340/440 | 0.77 | m |

someone speaking in a room with strong resonances, as some frequencies will be amplified by the resonance and will hang around long after the speaker has moved on to their next syllable.

Baroque buildings are often better than modernist buildings for resonances as they have more pillars, curved surfaces, panels and statues to break up standing waves, giving a more general reverberation rather than specific resonant frequencies.

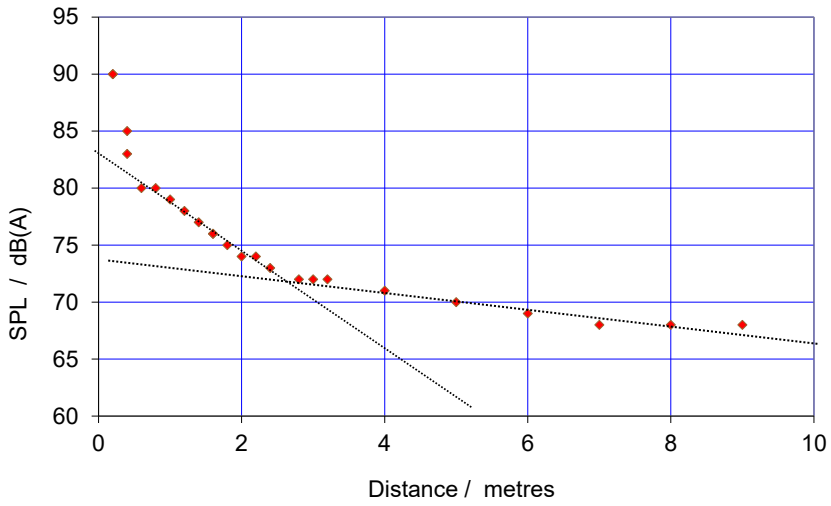
### *Echoes*

In some large rooms, it is possible to hear echoes of the sound reflecting off the end wall. Outdoors in mountainous areas, one can sometimes hear echoes from the other side of a valley. The human ear cannot distinguish an echo from the original sound if they arrive less than about 0.1 seconds apart. Therefore, you only get identifiable echoes if the *there-and-back* distance from the speaker to the reflecting wall is greater than 340 m/s (speed of sound) multiplied by 0.1 s = 34 m. Most rooms used by U3A groups are smaller than this, but a shorter echo can exacerbate other problems with resonances and reverberation.

### *Critical distance*

In any room, if someone is listening to a speaker, some of what they hear will come direct, some will reflect off the walls, ceiling and floor. If the listener moves away, the direct sound will reduce but the reverberant sound will stay much the same until eventually they are equal. As they move further apart the reverberant sound dominates. This distance is referred to as the critical distance $C_D$ or colloquially as room radius.[8]

The following diagram shows a calculation of $C_D$ for the QMH meeting room before it was refurbished. It shows the sound pressure level at different distances from an off-tune portable radio :




[8] How the critical distance is calculated is shown here: https://service.shure.com/s/article/critical-distance-and-microphone-placement?language=en_US&region=en-US

It can be seen that, at about 2.5 metres, there is a step in the line. This is the critical distance, beyond which the sound level from reverberation exceeds the direct sound level, and listening becomes increasingly difficult, particularly for people reliant on hearing aids. Also, it is the maximum distance at which you could place a microphone for reasonable reception of what the speaker is saying. (Ideally, you want the microphone at less than half $C_D$, to prevent a “bathroom acoustic”.)