KASTURI

KASTURI TECHNOLOGY
MALAYSIA

2026 EDITION · VENDOR NEUTRAL

The Meeting Room AV Buyer Guide

How to specify, budget and commission video conferencing and audio visual systems for corporate spaces. From a two person focus booth to a divisible town hall.

ROOM DESIGN | ACOUSTICS | CAMERAS AND AUDIO | SWITCHING AND CONTROL | BUDGETS IN MYR | RFP TEXT

51 PAGES · 20 DIAGRAMS · 5 WORKSHEETS

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READ THIS FIRST

How to use this guide

Most meeting room projects go wrong before a single product is chosen. The room is the wrong shape, the ceiling cannot carry what the design needs, or the audio was never given a budget line. This guide is written to be read in the order the decisions actually happen.

THREE WAYS TO USE IT

- **Front to back** if you are planning a fit out or a rollout. Parts 2 and 3 will change your architectural drawings, so read them before the ceiling grid is set.
- **By room type** if you are fixing one space. Find your room in the matrix on page 6, then jump to the pages it points at.
- **As a tender pack** if you are going out to quotation. Part 7 gives a site survey form, three checklists and specification text, and Appendix A the standards to cite.

WHAT EVERY RECOMMENDATION IS BASED ON

Technical numbers come from a published standard, a manufacturer specification or a measurement we can repeat on site. Commercial numbers are Kasturi planning estimates from our own project history as at September 2026, not quotations. The standards referenced most often are:

- **ANSI/AVIXA V202.01:2026** DISCAS, display image size for 2D content
- **ANSI/AVIXA V201.01:2021** image system contrast ratio
- **ANSI/AVIXA A102.01:2022** audio coverage uniformity in listener areas
- **Teams Rooms** and **Zoom Rooms** room classes, and **MS 1525:2019** for lighting
- Seven further AVIXA standards, in Appendix A, page 48

WHO THIS IS FOR

IT managers, facilities and workplace leads, office managers, architects and interior designers, and the finance person who approves the number. No AV background is assumed. Every calculation is shown so an engineer can check it, and summarised so you do not have to.

ONE RULE ABOVE ALL

People forgive a mediocre picture. They will not forgive bad audio. If your budget is under pressure, protect the microphone, the loudspeaker and the acoustic treatment before you protect the screen size.

UNITS USED

Metric throughout, except display sizes in inches because that is how they are sold. Budgets in ringgit excluding SST, indicative supply and install ranges for the Klang Valley as at September 2026, not a quotation.

0.4 to 0.6 s
RT60 target for a meeting room. Above 0.8 s no microphone will save you.

4x or 6x
Image height multiplier that sets your display size, depending on content.

NC-30
Background noise ceiling. Most Malaysian offices sit above it because of the aircon.

30 to 40%
Share of a healthy room budget that should go to audio and acoustics.

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A The standards this guide is built on 48

THE FIVE PAGES TO READ FIRST

If you only have twenty minutes before a meeting about this project, read these:

- **Page 6**, the room type matrix, to place your room
- **Page 15**, sightlines, to size the display correctly
- **Page 17**, acoustics, for the constraint that decides everything
- **Page 25**, bar or modular, the biggest cost decision
- **Page 40**, budget bands, for the number you have to defend

PART ONE

Before you buy anything

The five constraints that decide whether a room works, who owns which decision between the interior designer, the M&E contractor and IT, and how to write a brief that gets you comparable quotations instead of three unrelated proposals.

1.1
Why meeting rooms fail

1.2
Who owns what, and when

1.3
Writing a brief that gets comparable quotes

1.1 Why meeting rooms fail

In almost every room that people avoid booking, the equipment is fine. What failed was one of five constraints that sit outside the equipment list and are usually decided by someone who was never asked about video conferencing.

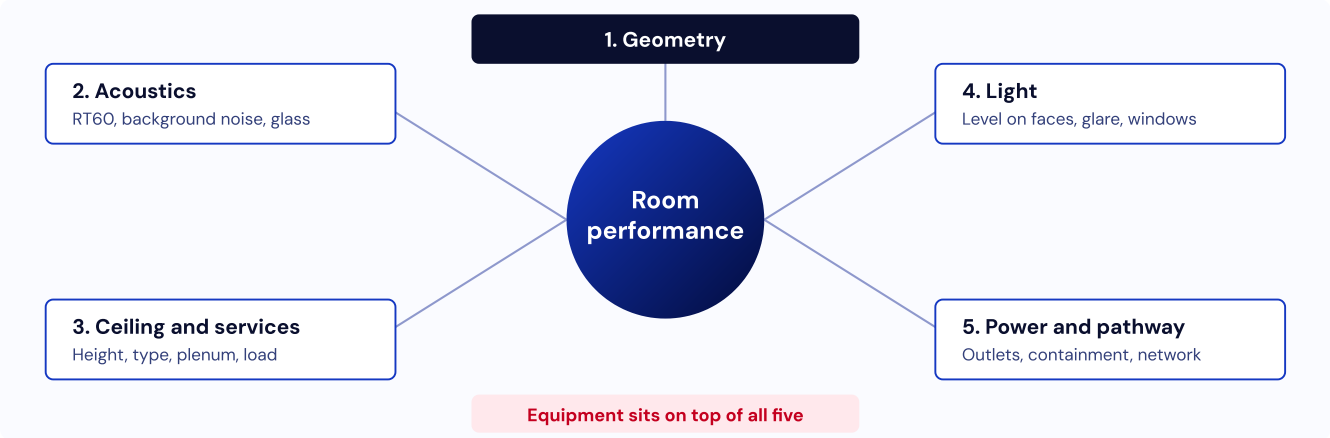


Figure 1.1 Equipment cannot compensate for a constraint that was decided wrongly. A beamforming ceiling array in a room with RT60 of 1.1 seconds still sounds like a bathroom.

THE FIVE FAILURES WE FIND MOST OFTEN

1. **The table is too long for the camera.** A 6 m table with a single front of room bar puts the far end people at 12 to 15 pixels of face height. They stop being visible as humans.
2. **Untreated glass on two or three walls.** Modern Malaysian offices love glass meeting rooms. Glass is acoustically reflective on every frequency that matters for speech.
3. **The aircon is louder than NC-40.** Ducted fan coil units sitting directly above the table raise the noise floor so far that automatic gain control chases the aircon, not the talker.
4. **No power or conduit in the table.** Discovered on install day, solved with a cable taped to the carpet, which the office then lives with for five years.
5. **Nobody owns the room after handover.** No firmware policy, no monitoring, no named person. Quality decays quietly until the room gets a reputation.

THE CHEAPEST FIX IS ALWAYS EARLIER

Moving a ceiling speaker on a drawing costs nothing. Moving it after the ceiling is closed costs a day of labour, a patch, a repaint and a delayed handover. Every constraint in this chapter is free to fix at design stage and expensive to fix later.

WHAT "IT DOES NOT WORK" USUALLY MEANS

"They cannot hear us"	Mic distance, RT60 or noise floor
"We cannot hear them"	Speaker placement or level, not the codec
"There is an echo"	AEC defeated by reflections or a second open device in the room
"You look far away"	Camera to farthest seat distance and framing mode
"It takes ten minutes to start"	Cable choice, source switching, or no one owns the room

1.2 Who owns what, and when

On a fit out there are usually four parties and no agreed boundary. The AV integrator is appointed last, after the decisions that constrain them have already been made. This table is the boundary we recommend you write into the tender.

RESPONSIBILITY MATRIX FOR A TYPICAL CORPORATE FIT OUT

ITEM	INTERIOR DESIGNER	M&E CONTRACTOR	IT	AV INTEGRATOR
Room dimensions and table position	Owns	–	Consulted	Consulted, must sign off sightlines
Ceiling type, height, grid setting out	Owns	Coordinates	–	Consulted, provides device positions
Acoustic treatment	Owns delivery	–	–	Owns the specification and the target
Lighting layout and dimming	Owns	Installs	–	Consulted, specifies level on faces
Power outlets, floor boxes, table grommets	Locates	Owns	–	Provides schedule and load
Containment, conduit, back boxes	–	Owns	–	Provides route and size
Structured cabling to the rack	–	Often owns	Owns standard	Provides count and category
Network ports, VLAN, QoS, PoE budget	–	–	Owns	Provides requirements
Wall reinforcement behind displays	Coordinates	Owns	–	Provides load and mounting height
AV equipment, programming, commissioning	–	–	Consulted	Owns
Platform licences and room accounts	–	–	Owns	Consulted
Day two support and monitoring	–	–	Owns or contracts	Delivers under contract

The order of operations

Bring the AV integrator in at the point marked below. Every week later than this costs money, and the three shaded activities cannot be undone once the ceiling closes.

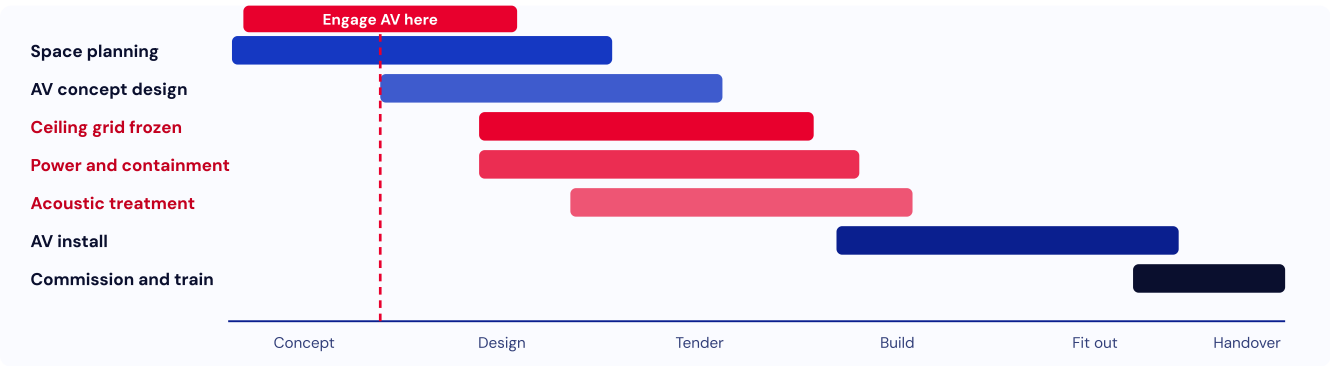


Figure 1.2 Red bars are one way doors. Once the ceiling grid is set out and the containment is cast or installed, the AV design is constrained by decisions it did not make.

1.3 A brief that gets comparable quotes

Three integrators given a vague brief will return three proposals you cannot compare, because each has silently assumed a different room, a different platform and a different scope boundary. Eleven facts remove almost all of that ambiguity.

THE ELEVEN FACTS

1. **Room dimensions** in metres, plus ceiling height and ceiling type.
2. **Table size, shape and position**, or a note that it is not yet chosen.
3. **Seated capacity** at the table and total occupancy including wall seating.
4. **Platform**. Teams, Zoom, Google Meet, Webex, or bring your own meeting.
5. **Content type**. Slides and video only, or spreadsheets, CAD and dense data.
6. **Guest sharing**. Do external visitors need to present without joining your network.
7. **Recording or streaming** requirement, now or in the next two years.
8. **Existing infrastructure**. Rack location, spare network ports, PoE availability.
9. **Scope boundary**. Who supplies power, containment, wall reinforcement and the table.
10. **Standardisation**. Is this one room or the template for twenty.
11. **Budget range and approval date**. A range is not a weakness, it is a filter.

ASK FOR THE SAME THREE THINGS BACK

A bill of quantities with model numbers and quantities, a single line drawing showing signal flow, and a clear list of exclusions. Any proposal missing the exclusions list is not a proposal, it is a price.

QUESTION SET THAT SEPARATES GOOD INTEGRATORS FROM BOX SHIFTERS

- What RT60 does this room need, and how will you verify it after treatment?
- What is the distance from the camera to the farthest seat, and what face height does that give?
- What is the microphone to farthest talker distance, and does it meet the platform class?
- How many loudspeakers, and what is the level variation across the seating area?
- What happens if the network is down. Does the room still work locally?
- What is handed over. Drawings, IP schedule, credentials, configuration backup?
- Who answers the phone in year two, and what is the response time in writing?

SCOPE TRAPS THAT INFLATE VARIATION ORDERS

Table cable cutout and grommet	Usually the furniture supplier, often nobody
Wall backing for a 98 inch display	Main contractor, needs 6 weeks notice
Making good after ceiling works	Rarely in the AV price
Network ports and patching	IT, but AV needs the count early
Furniture modification	Almost never included
After hours access and lift booking	Priced as a variation if not stated

A completed site survey form is on page 43. Sending that form with your enquiry replaces about two weeks of back and forth.

PART TWO

The room itself

Twelve space types, eight of them drawn to scale, then the six fit out decisions that constrain every piece of equipment that follows, from the table to the power outlets.

2.1
The room type matrix

2.2
Twelve space types

2.3
Table shape, size and connectivity

2.4
Sightlines and viewing geometry

2.5
Ceilings, height and services

2.6
Acoustics, the decisive constraint

2.7
Lighting for camera

2.8
Power, containment and pathways

2.1 The room type matrix

Find your space in the left column. The row gives you the geometry to design to and the page where the scaled plan and equipment logic sit. Areas assume a 2.7 m clear ceiling unless noted.

CORPORATE SPACE TYPES, DIMENSIONS AND DEFINING CONSTRAINT

SPACE	PAX	TYPICAL SIZE	AREA	DISPLAY	AUDIO APPROACH	THE CONSTRAINT THAT DECIDES EVERYTHING
Focus booth	1 to 2	1.2 x 1.5 m	2 m²	24 to 32 in	Personal device or bar	Ventilation and self noise of the pod fan
Huddle room	3 to 5	3.0 x 2.7 m	8 m²	55 in	All in one bar	Camera to nearest face under 1.2 m causes distortion
Small meeting room	4 to 6	4.9 x 4.9 m	24 m²	55 to 65 in	All in one bar	Mic to farthest talker within 2.0 m
Standard meeting room	6 to 12	5.5 x 6.0 m	33 m²	65 to 86 in	Bar plus expansion mic, or modular	Mic to farthest talker within 2.4 m
Large meeting room	12 to 16	4.5 x 9.8 m	44 m²	110 in, 86 in accepted	Modular, ceiling mic, ceiling speakers	Room length beyond 8 m defeats a single bar
Boardroom	16 to 24	7.0 x 12.0 m	84 m²	136 in LED, dual 98 in accepted	DSP, two ceiling arrays, distributed speakers	Farthest viewer distance and table width
Training room	20 to 40	8.0 x 12.0 m	96 m²	Dual 98 in or LED	DSP, voice lift, wireless mics	Reinforcing the trainer to the back row
Divisible room	2 x 20	8.0 x 16.0 m	128 m²	2 x 98 in per half	DSP with presets and partition sensing	Acoustic isolation of the moving wall, typically Rw 45 to 50
Town hall	60 to 200	12 x 20 m plus	240 m²	LED wall or projection	Line array or distributed, wireless mics	Reverberation and coverage uniformity
Briefing centre	10 to 20	7.0 x 10.0 m	70 m²	LED wall, 2.5 mm or finer	DSP with programme audio	Ambient light control and content pipeline
Control room	4 to 12	6.0 x 9.0 m	54 m²	LCD or LED wall, 24/7	Operator intercom, low level ambient	Continuous duty rating and heat load
Lobby and reception	Transient	Wall dependent	–	LED wall or LCD	Usually mute, discreet speakers	Ambient light and viewing distance to pixel pitch

THE ONE NUMBER THAT RECLASSIFIES A ROOM

Microphone to farthest talker. Under 2.4 m an all in one bar is honest. Beyond it, no amount of beamforming will make the far end sound close. Measure it before you choose anything.

ASPECT RATIO MATTERS MORE THAN AREA

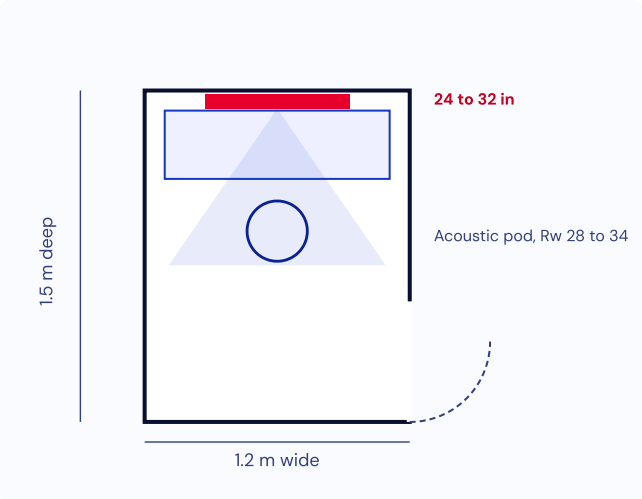
A 44 m² room at 4.5 x 9.8 m and a 44 m² room at 6.6 x 6.6 m need completely different systems. The long room needs modular audio and probably two displays. The square room does not.

COUNT THE WALL SEATS

Rooms are specified by seats at the table and used by everyone who squeezes in. Wall seats sit outside mic coverage and outside camera framing. Design for the real occupancy or accept that those people are invisible.

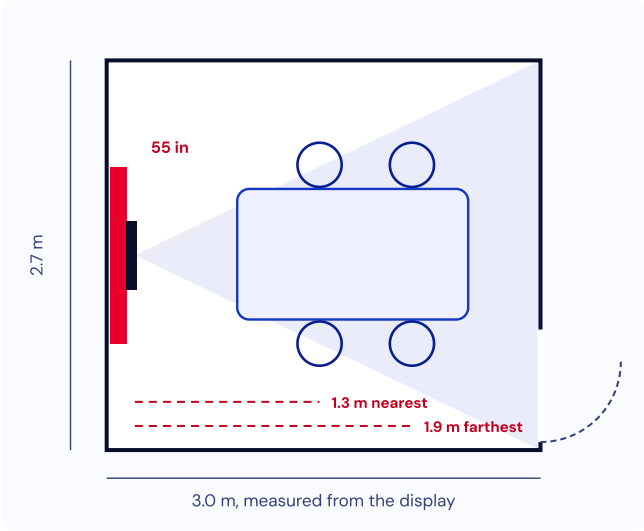
2.2 Focus booth and huddle room

FOCUS BOOTH, 1 TO 2 PEOPLE



- The device is usually a laptop plus a personal speakerphone, not a room system.
- Pod fan noise is the failure mode. Ask for the measured dB(A) at seated head height, not the marketing figure. Anything above 40 dB(A) will be audible on every call.
- Provide two power sockets and one data port inside the pod, plus a USB-C 65 W charge cable.
- Glass fronted pods need a soft rear wall or the occupant hears their own voice slap back.

HUDDLE ROOM, 3 TO 5 PEOPLE



- One all in one bar under the display does everything. Do not add a table microphone, it will fight the bar's echo canceller.
- Keep the nearest face at least 1.2 m from the camera. Closer than that and a wide lens distorts faces, which reads as unflattering rather than immersive.
- A 55 in display has an image height of 0.69 m. At a farthest viewer distance of 1.9 m that is 2.8 image heights, comfortably inside the analytical threshold of 4. A huddle room is one of the few spaces where the default display is genuinely large enough for spreadsheets.
- Single cable to the table. A USB-C tether that carries video, USB and power is the only connection most huddle rooms need.

FOCUS BOOTH, DESIGN TARGETS	
Internal footprint	**1.0 x 1.2 m minimum**
Ventilation	**Under 40 dB(A)**
Display	**24 to 32 in**
Power and data	**2 x 13 A, 1 x RJ45**
Lighting, vertical	**300 to 400 lux**

HUDDLE ROOM, DESIGN TARGETS	
Camera to nearest face	**1.3 m**
Camera to farthest face	**1.9 m**
Display	**55 in**
RT60	**0.4 to 0.5 s**
Table	**1 x USB-C, 2 x 13 A**

BOOTHS ARE FURNITURE, NOT AV

Pods arrive from a furniture supplier with a fan, a light and a socket. Get the AV requirement in before the order: bracket position, a data point, and whether the pod can be drilled without voiding the warranty.

THE HUDDLE ROOM UPGRADE NOBODY NEEDS

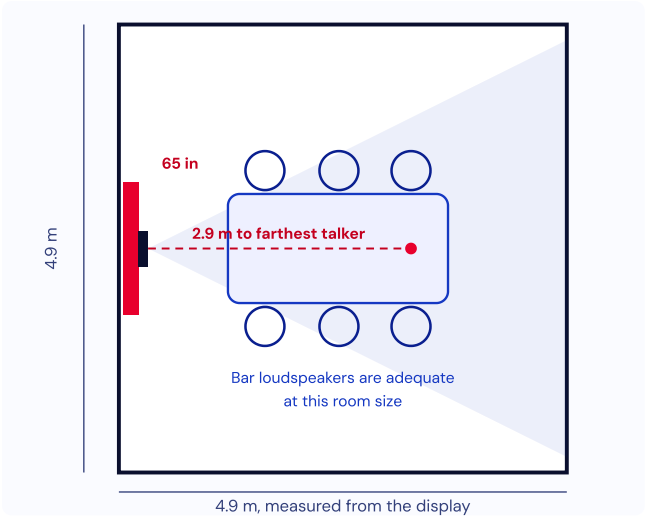
A touch console adds cost, another device to update and one more thing to explain. A single cable and the platform's own controls are faster. Save it for rooms with two sources.

WHERE HUDDLE ROOMS ACTUALLY FAIL

Not the equipment. The door is glass, the corridor is noisy and the room has no absorption at all. One absorbent ceiling fixes almost all of it.

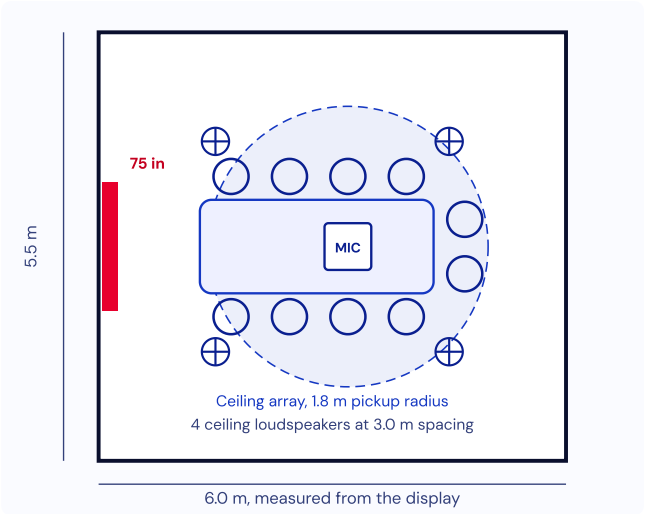
2.2 Small and standard meeting rooms

SMALL MEETING ROOM, 4 TO 6 PEOPLE, 4.9 X 4.9 M



DESIGN CHECK	
Farthest viewer	**3.2 m**
Display, basic content	**43 in minimum**
Display, analytical content	**65 in**
Camera to farthest face	**3.2 m**
Mic to farthest talker	**2.9 m**

STANDARD MEETING ROOM, 6 TO 12 PEOPLE, 5.5 X 6.0 M



DESIGN CHECK	
Farthest viewer	**4.7 m**
Display, basic content	**65 in**
Display, analytical content	**98 in**
Camera to farthest face	**4.9 m**
Mic to farthest talker	**1.8 m**

THE SMALL ROOM CONTRADICTION, AND HOW TO RESOLVE IT

Platform guidance puts the microphone within about 2.0 m of the farthest talker in a small room and 2.4 m in a medium room. With the table pointed at the display, as it should be, a bar mounted under the screen in a 4.9 m room still sits about 2.9 m from the last seat. The three honest resolutions, in order of preference: pull the table forward so the last seat is under 2.6 m from the bar, add one table microphone puck cabled to the same bar so a single echo canceller still owns both, or move the microphone to the ceiling above the table centre. Adding a second independent microphone system is not on that list. Two echo cancellers in one room fight each other, and the symptom users report is clipped first syllables.

IF THE ROOM IS ALL GLASS

Treat the ceiling across the full area with a tile rated NRC 0.85 or better, and put carpet with underlay on the floor. Between them that is usually enough to reach the target without touching the glass. Budget roughly RM 250 to 600 per square metre of treated surface.

IF THE TABLE CANNOT MOVE

Where the table position is fixed by the furniture contract and the far edge is beyond 2.6 m from the bar, add one table microphone cabled to the bar. Do not add a second independent system, and do not accept "the beamforming will handle it" without a distance figure.

IF THE CEILING IS FLUSH PLASTERBOARD

Every device position becomes permanent, so the reflected ceiling plan has to be agreed and signed before the board goes up. Allow an extra week in the programme and confirm the clear depth above the board at each position, not just at one point in the room.

2.2 Large meeting room, 12 to 16 people

At 4.5 x 9.8 m this is the room where an all in one bar stops being honest. The room is more than twice as long as it is wide, so a single device at the front cannot hold both ends of the table in frame or in microphone range.

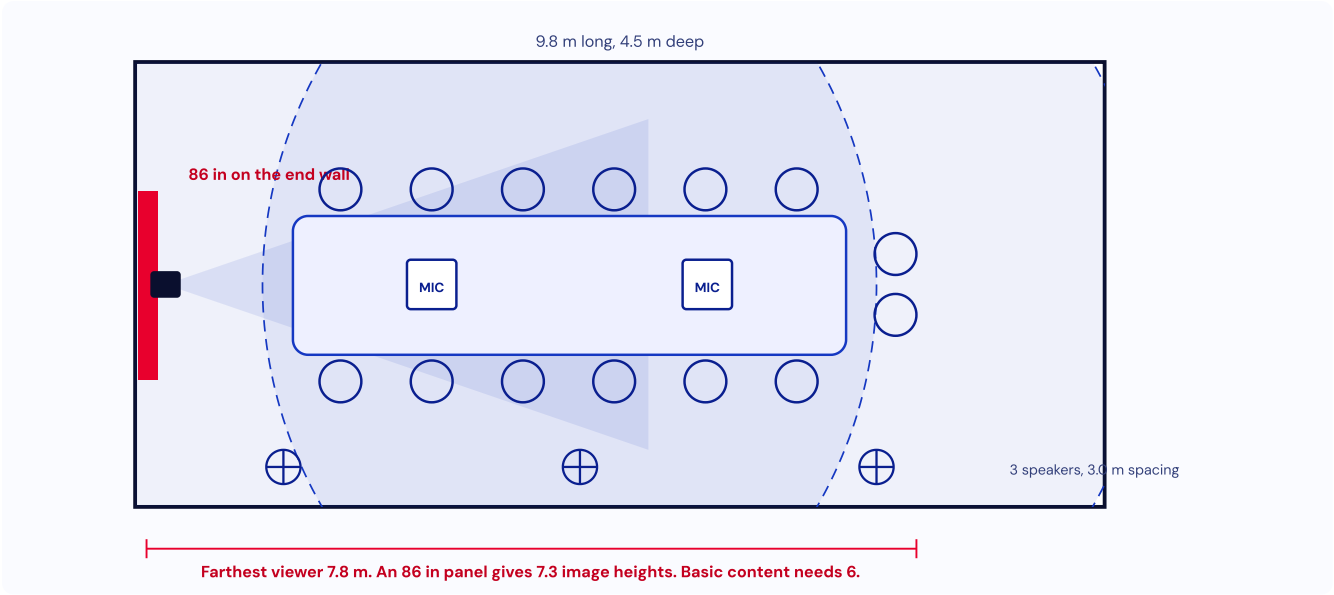


Figure 2.2 Two ceiling arrays over the table thirds, three ceiling loudspeakers and a front of room camera. Shaded circles are the pickup area of a 9 x 9 m class ceiling array at 2.7 m ceiling height, clipped to the room.

THE DISPLAY WILL BE UNDERSIZED

At 7.8 m the farthest viewer needs 1.30 m of image height for basic content, which is a 104 in diagonal, and 1.95 m for analytical content, which is a 157 in LED. An 86 in panel is the size that fits the wall and the budget, not the size the room needs. Say so during design, not at handover.

THREE WAYS TO CLOSE THE GAP

- Move to a 110 in panel or a 136 in fine pitch LED on the end wall.
- Add a repeat display at the midpoint of one long wall for the back half of the table.
- Accept basic content only, and record that decision in the handover notes so nobody is surprised when a spreadsheet is unreadable from seat 12.

WHY TWO MICROPHONE ARRAYS

A single array centred in a 9.8 m room puts the end seats 4.4 m away, well outside the distance where a beamformer holds a usable signal to noise ratio. Two arrays at the table thirds put every seat within 2.4 m, and the DSP gates between them so only the active zone opens.

THE CHEAPEST FIX FOR A LONG ROOM IS TO STOP TREATING IT AS ONE ROOM

Before spending on a second camera and a third ceiling array, ask whether the far third of the table is ever used. In many long rooms the last four seats are occupied twice a year. If that is true, design the system for the seats that are used, put the remaining chairs against the wall, and spend the saving on acoustics. If it is not true, design for the full length and accept the modular cost. What you cannot do is design for eight seats and sell it as a room for sixteen.

2.2 Boardroom, 16 to 24 people

A 7.0 x 12.0 m boardroom is the point where the room becomes a small auditorium wearing a table. Every subsystem moves up a class: a DSP instead of an appliance, distributed loudspeakers instead of a soundbar, and a display that almost nobody budgets correctly.

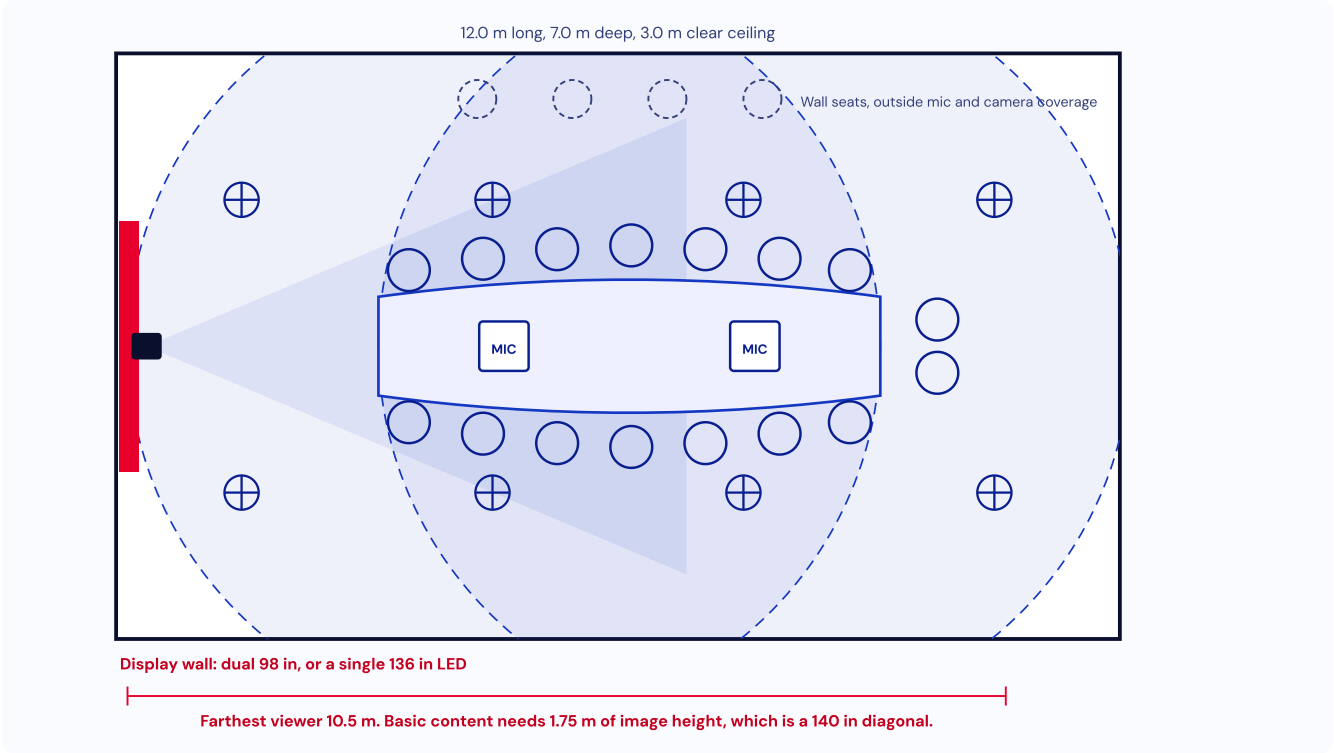


Figure 2.3 Two ceiling arrays over the table thirds, eight ceiling loudspeakers on a 3.0 m grid, camera at the display wall. The dashed seats along the wall are the ones every boardroom actually uses and no boardroom design accounts for.

DISPLAY SIZING, THE HONEST VERSION

Farthest viewer	**10.5 m**
Basic content needs	**1.75 m**
Equivalent diagonal	**140 in**
Dual 98 in gives	**8.6 H**
Practical answer	**136 to 163 in LED**

LOUDSPEAKER LAYOUT MATHS

Ceiling height	**3.0 m**
Seated ear height	**1.2 m**
Throw distance	**1.8 m**
Coverage at 90 degrees	**3.6 m**
Spacing, 17 percent overlap	**3.0 m**
Count	**8, in 2 rows**

BOARDROOMS NEED A RACK, OUTSIDE THE ROOM

DSP, amplifier, switcher, codec and control all need power, cooling and service access. Allow a 12U to 18U rack in an adjacent store or riser, not a cupboard inside the room. Fan noise inside the room raises the noise floor you just spent money lowering.

THREE THINGS THAT ONLY APPEAR AT THIS SIZE

- Two cameras and a director. One lens cannot serve a 6 m table.
- Wireless microphones for guests presenting from the far end.
- Assistive listening.

CONFIDENTIALITY IS A CONSTRUCTION DETAIL

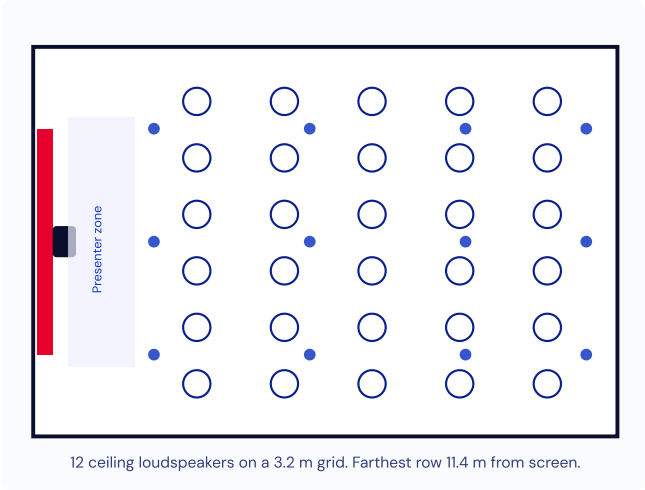
Partitions to the slab, penetrations sealed, an acoustically sealed door. Rw 50 is the target. No processing fixes a wall that stops at the ceiling tile.

THE CHAIR SITS AT THE HEAD OF THE TABLE

So the person who matters most is furthest from the display. Check the sightline and framing from that seat. It is the seat the room is judged from.

2.2 Training rooms and divisible spaces

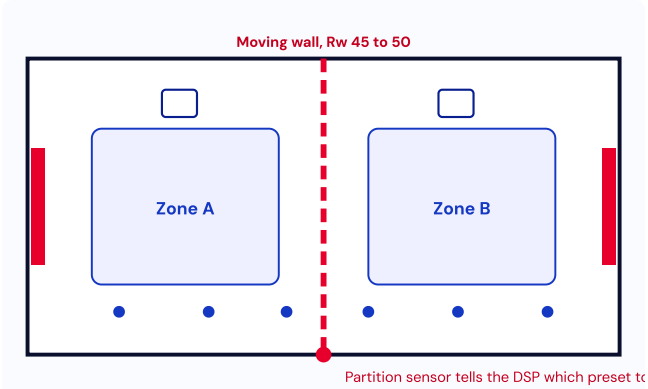
TRAINING ROOM, 20 TO 40 PEOPLE, 8.0 X 12.0 M



12 ceiling loudspeakers on a 3.2 m grid. Farthest row 11.4 m from screen.

- **Voice lift is the point.** A trainer speaking for three hours to row five needs gentle reinforcement, typically 3 to 6 dB above their natural level at the back, not amplification you can hear as amplification.
- Ceiling loudspeakers must be dense enough that nobody sits between two lobes. At 3.2 m ceiling and 4.0 m coverage diameter, 3.2 m spacing is the practical grid.
- Farthest row at 11.4 m needs 1.9 m of image height for basic content. That is a 153 in diagonal, so this room is an LED wall or dual projection, not a panel.
- Two wireless microphones minimum: one handheld for questions from the floor, one lavalier or headset for the trainer. Budget for spare batteries and a charging dock, not just the radios.

DIVISIBLE ROOM, 2 X 20 PEOPLE, 8.0 X 16.0 M



THE THREE STATES A DIVISIBLE ROOM MUST HANDLE

STATE	AUDIO	VIDEO	CONTROL
Divided	Two independent DSP zones, no crosstalk	Each display fed from its own zone source	Two touch panels, each locked to its zone
Combined	One zone, one echo canceller, delay aligned	Both displays mirror the primary source	Primary panel takes control, secondary follows
Combined with overflow	Zone B is listen only, mics muted	Zone B mirrors, no share privileges	Primary panel only

The acoustic rating of the moving wall decides whether "divided" is real. A wall rated Rw 35 leaks enough speech that the two rooms cannot run separate calls. Specify Rw 45 as the minimum and Rw 50 where confidential sessions run either side, and check that the wall is sealed to the slab, not just to the ceiling tile.

PLANNING WIRELESS MICROPHONES

- Two channels minimum, four for a room that runs panel sessions.
- One antenna distribution system, not four receivers with stub antennas behind a curtain.
- A charging dock in the rack, so batteries are never the reason a session starts late.

FURNITURE DECIDES THE TRAINING ROOM

Fixed rows, mobile tables or clusters change the microphone plan, the loudspeaker density and whether presenter tracking is worth having. Get the furniture layout agreed before the ceiling plan, because in a training room the seating is the design.

WHAT A DIVISIBLE ROOM COSTS TO GET WRONG

A divisible room that cannot reliably run two independent sessions is just a large room with a wall in it, and the organisation loses the booking capacity it paid for. Test the transitions at commissioning, both directions, and test them again with real meetings running on both sides before you sign.

2.2 Town hall, briefing centre and control room

Three specialist spaces built from the same components as a meeting room and almost none of the same rules. Each is defined by one dominant requirement that overrides normal practice.

TOWN HALL, 60 TO 200 PEOPLE

A flat floor multipurpose space used for all hands sessions, product launches and occasionally training. The dominant requirement is **intelligibility at the back row**, which is an acoustics problem before it is a loudspeaker problem.

DESIGN TARGETS	
RT60, 500 Hz to 2 kHz	**0.6 to 0.9 s**
Background noise	**NC-30 or lower**
Level variation	**Within 6 dB**
Speech transmission	**STI 0.60 or better**
Screen	**LED, 1.5 to 2.5 mm**

- Distributed ceiling loudspeakers beat a single front pair once the room is deeper than about 15 m. A front pair loud enough for the back row is painful in the front row.
- Budget four to six wireless channels and a proper antenna distribution, not four separate receivers with stub antennas behind a curtain.

EXECUTIVE BRIEFING CENTRE

A sales and storytelling space. The dominant requirement is **image quality under controlled light**, because the room exists to make a product look inevitable.

DESIGN TARGETS	
LED pixel pitch	**1.2 to 2.5 mm**
Closest viewer, metres	**Pitch in mm x 1.5**
Ambient light on screen	**Under 100 lux**
Wall behind screen	**Dark, matt**
Content pipeline	**Dedicated playback PC**

- Lighting must be zoned and dimmable. One scene for presentation, one for conversation, one for cleaning. Without scenes the room gets used with the lights full on and the LED looks flat.
- Specify the content workflow at the same time as the screen. An LED wall with nobody responsible for what plays on it becomes an expensive screensaver.

CONTROL ROOM

Continuous duty monitoring. The dominant requirement is **reliability over 24 hours a day for five years**, which changes almost every product choice.

DESIGN TARGETS	
Display duty rating	**24/7**
Ambient light, indirect	**150 to 300 lux**
Operator viewing distance	**1.5 to 3.0 m**
Noise, all kit running	**NC-35**
Redundancy	**Dual power, spares on site**

- Heat is the design driver nobody costs. A wall of displays plus processing plus operators will change the cooling load, and the M&E design must be told the number in watts.
- Consumer or standard commercial panels fail early on continuous duty. The warranty wording matters more than the specification sheet.

THE RULE THAT CONNECTS ALL THREE

In a meeting room the equipment serves a conversation. In these three spaces it serves an outcome someone is measured on: a message delivered to the whole company, a deal advanced, an incident caught early. Specify to the outcome and the components follow. Specify to a product list and you will buy a meeting room that happens to be large.

2.2 Lobby, reception and video walls

A lobby screen has no meeting to support, so the only two questions are how close people stand and how bright the space is. Get those two right and the rest is content discipline.

CHOOSING BETWEEN LCD AND DIRECT VIEW LED

FACTOR	TILED LCD	DIRECT VIEW LED
Sensible size range	Up to about 130 in diagonal	Any size, and the only option above 130 in
Seams	0.9 to 3.5 mm bezel between panels	None
Brightness	500 to 700 nits typical	600 to 1,500 nits indoor, higher available
Minimum viewing distance	Any, pixel density is high	Pitch in mm x 1.5 for comfortable viewing
Shape freedom	Rectangular grids only	Any ratio, curves, columns, wraps
Service	Replace a whole panel	Replace one module, front or rear access
Relative cost	Lower below 110 in	Higher, and falling

Pixel pitch and how close people actually stand

The common rule of thumb is that comfortable viewing distance in metres is roughly the pitch in millimetres multiplied by 1.5, and that content reads cleanly from about pitch multiplied by 3. Measure where people genuinely stand in your lobby before buying a finer pitch. The step from 2.5 mm to 1.5 mm can double the screen cost and is invisible to someone standing 6 m away.

PIXEL PITCH SELECTION BY NEAREST VIEWER

NEAREST VIEWER	PITCH TO SPECIFY	TYPICAL USE
Under 1.5 m	0.9 to 1.2 mm	Briefing centre, touch enabled wall
1.5 to 2.5 m	1.5 mm	Reception desk backdrop
2.5 to 4.0 m	1.8 to 2.5 mm	Lobby feature wall
4.0 to 8.0 m	2.5 to 3.9 mm	Atrium, large hall
Over 8.0 m	4.0 mm and coarser	Town hall, external facing

BRIGHTNESS IS DECIDED BY THE WINDOW, NOT THE SCREEN

A lobby with a glazed facade can exceed 3,000 lux on the wall at midday. A 500 nit LCD will look grey and switched off. Measure the lux on the wall at the worst hour before choosing, and if you cannot control the glazing, specify a high brightness product and accept the cost.

STRUCTURE AND POWER COME FIRST

- Direct view LED walls are heavy. Get the load per square metre to the structural engineer before the wall is built, not after.
- Dedicated circuits, not a spur off the lighting. A 10 m² wall can draw several kilowatts at peak white.
- Leave a service gap or specify front service. Retro fitting access is impossible.
- Heat rises into the void above the wall. Tell the M&E designer.

CONTENT IS THE PART THAT FAILS

Most disappointing lobby screens are technically perfect and showing a four year old loop. Before signing the hardware order, name the person who owns the content, the software that schedules it, and the review cadence. If none of those three has an answer, buy a smaller screen.

2.3 The table decides more than the furniture budget

The table sets the camera distance, the microphone distance and where power has to come out of the floor. It is usually chosen by the interior designer from a catalogue, months before anyone asks what the room has to do.

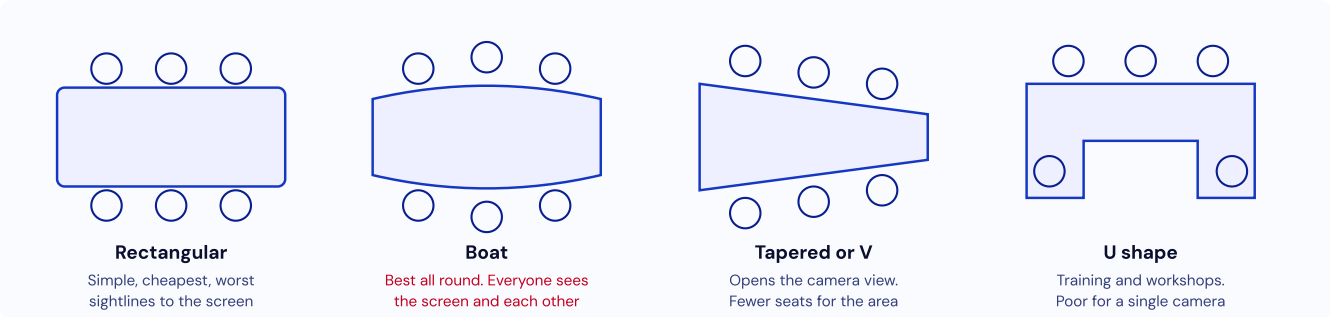


Figure 2.4 Seat positions shown as circles. In a boat table the widened centre pushes the middle seats back so the end seats are not looking along a row of shoulders.

TABLE SIZE BY SEATED CAPACITY

SEATS	LENGTH	WIDTH	ROOM NEEDED	EDGE PER PERSON
4	1.8 m	0.9 m	3.6 x 2.7 m	0.75 m
6	2.4 m	1.2 m	4.2 x 3.0 m	0.70 m
8	3.0 m	1.2 m	4.8 x 3.6 m	0.70 m
10	3.6 m	1.4 m	5.4 x 3.9 m	0.70 m
12	4.2 m	1.4 m	6.0 x 4.2 m	0.70 m
14	4.8 m	1.6 m	6.6 x 4.5 m	0.70 m
16	5.4 m	1.6 m	7.2 x 4.8 m	0.70 m
20	6.6 m	1.8 m	8.4 x 5.4 m	0.70 m

Allow 0.9 m clear behind each chair, 1.2 m on the main route. A table that fills the room to within 0.7 m of the wall leaves one side nobody can use once chairs are pushed back.

THREE NUMBERS TO GIVE THE FURNITURE SUPPLIER

- **Table width at the widest point.** Beyond about 1.8 m the people opposite are far enough away that a single ceiling array starts to struggle and faces get small in frame.
- **Cable route.** A closed pedestal with no cable path is the single most common furniture mistake. Ask for a spine or a leg with a 50 mm clear path to the floor box.
- **Cutout position and size.** Give a dimensioned position, not "somewhere in the middle". A grommet 300 mm out of place puts the cable across someone's notepad.

TABLE CONNECTIVITY BY ROOM SIZE

Huddle	1 x USB-C tether, 2 x 13 A
Small	1 x USB-C, 1 x HDMI, 4 x 13 A
Standard	2 x USB-C, 1 x HDMI, 6 x 13 A, 1 x data
Large	2 x connection points, 8 to 10 x 13 A
Boardroom	Power at every second seat, 2 to 3 connection points

Recessed cable wells that close flush look better than a permanently open grommet and stop the room filling with abandoned adaptors. Specify one that opens with one hand while the other hand holds a laptop.

2.4 Sightlines and viewing geometry

Display size is not a taste decision. ANSI/AVIXA V202.01:2026, known as DISCAS, sizes a display from the smallest element that has to be readable on it. The 4 and 6 image height ratios below are the common simplification of that method and they are good enough to plan with. Appendix A on page 48 explains what the standard actually does and where the free calculators are.

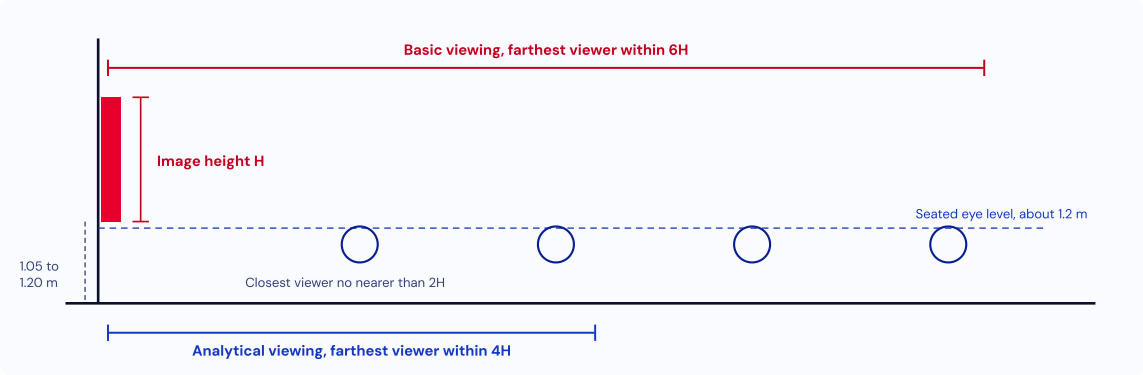


Figure 2.5 H is the height of the active image area, not the diagonal. For 16:9, image height is the diagonal multiplied by 0.49. A 65 in panel has an image height of 0.81 m.

DISPLAY SIZE BY FARTHEST VIEWER DISTANCE

FARTHEST VIEWER	BASIC CONTENT, 6H	ANALYTICAL CONTENT, 4H	COMMON COMPROMISE
2.5 m	34 in	50 in	55 in
4.0 m	54 in	80 in	75 in
5.0 m	67 in	100 in	86 in
6.0 m	80 in	120 in	98 in
7.5 m	100 in	151 in	Dual 98 in or LED
9.0 m	120 in	181 in	LED wall
11.0 m	147 in	221 in	LED wall

The first two columns are calculated minimums at a 16:9 ratio, so round up to the nearest panel you can actually buy. The right hand column is what gets installed in practice. Below about 6 m that compromise is generous. Above it, it becomes a real limitation.

GEOMETRY RULES THAT ARE NOT NEGOTIABLE

Horizontal viewing angle	**Within 45 degrees**
Preferred angle	**Within 30 degrees**
Vertical angle to top	**Under 35 degrees**
Bottom of screen	**1.05 to 1.20 m**
Closest viewer	**Not nearer than 2H**
Camera lens height	**1.1 to 1.5 m**

THE MOUNTING HEIGHT MISTAKE

Displays get mounted high so the logo looks good from the door. The people in the front row then spend an hour looking up at 40 degrees. Set the bottom edge at 1.05 to 1.20 m and accept that the room looks less impressive when empty and works better when full.

Two displays side by side do not improve viewing distance, because image height does not change. They are for showing content and people at once. If you need a bigger picture, buy one.

2.5 Ceilings, height and services

The ceiling is where the microphones, the loudspeakers, the lighting and the air all have to coexist. It is also the element most often finalised before anyone asks the AV designer a question.

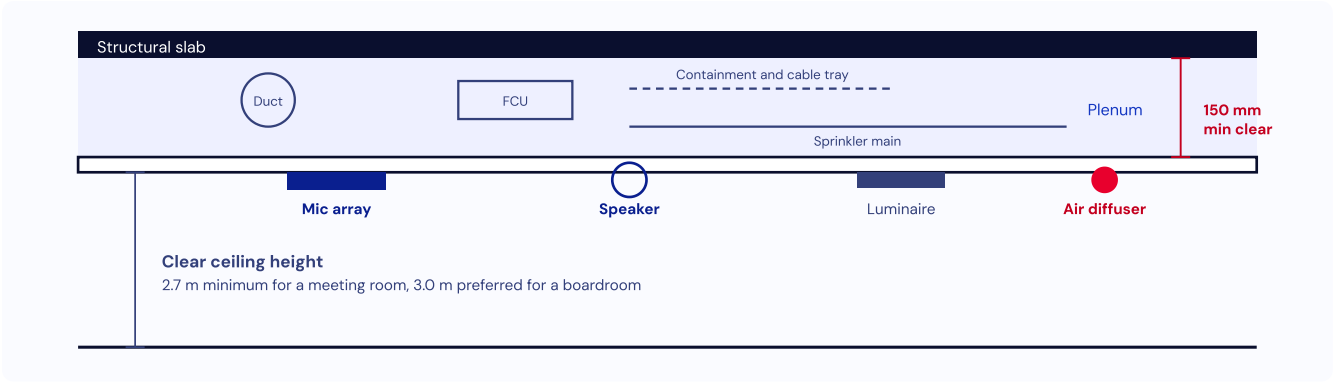


Figure 2.6 A flush ceiling microphone still needs clear depth above the tile for the unit body and cable radius. Allow 150 mm and check for the duct that is not on the drawing.

WHAT EACH CEILING TYPE ALLOWS

CEILING	FLUSH MIC ARRAY	CEILING SPEAKERS	NOTES
Mineral fibre tile, 600 x 600 T-bar	Yes, tile bridge kit	Yes, easy	Best case. Everything is serviceable and removable.
Mineral fibre tile, 600 x 1200	Yes, with a cut tile	Yes	Confirm the grid setting out against your device layout early.
Plasterboard, flush	Yes, but the cutout is permanent	Yes, with back boxes	Positions must be final before the board goes up. No second chances.
Metal strip or baffle	Usually suspended, not flush	Pendant or suspended	Coordinate with the ID for a designed suspension, not an improvised one.
Exposed services, no ceiling	Suspended array only	Pendant speakers	Acoustically the hardest case. Reverberation is usually the real problem.

THE THREE QUESTIONS TO ASK ON SITE

1. What is the clear height from finished floor to the underside of the ceiling, measured, not taken from the drawing?
2. How much clear depth is there above the tile at the exact positions we want, and what is in the way?
3. Is the ceiling void used as a return air plenum? If it is, every cable in it must be plenum rated and every penetration matters.

CEILING HEIGHT CHANGES THE AUDIO DESIGN

Coverage diameter for a loudspeaker is 2 x (ceiling height minus 1.2 m) x tan of half the dispersion angle. At 2.7 m you get 3.0 m of coverage from a 90 degree speaker. At 4.0 m you get 5.6 m, so you need fewer speakers but each is further from the listener and needs more level. High ceilings also add volume, which lengthens reverberation.

LOAD AND FIXING

Ceiling arrays and speakers must be independently supported from the slab, never hung from the tile grid alone. Give the main contractor the weight per device and the fixing positions before the ceiling is installed.

2.6 Acoustics, the constraint that decides everything

Two numbers decide whether a room can carry a conversation. RT60 is how long sound takes to decay by 60 dB. NC is how loud the room is when empty. Every microphone choice depends on both.

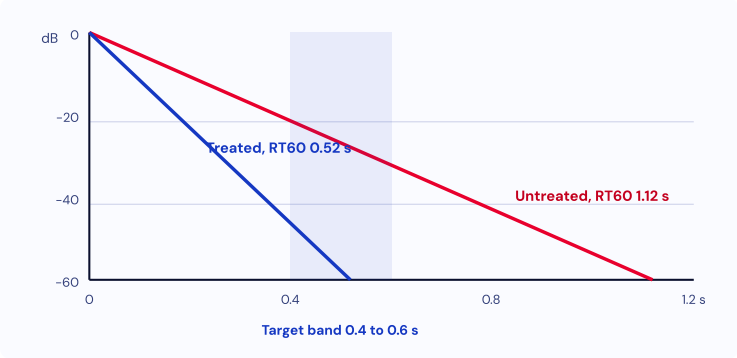


Figure 2.7 The same 5.5 x 6.0 x 2.7 m room before and after adding 20 m² of absorption at NRC 0.85.

THE WORKED EXAMPLE, SO YOU CAN CHECK OURS

Sabine's formula: **RT60 = 0.161 x V / A**, where V is room volume in cubic metres and A is total absorption in square metre sabins. For a 5.5 x 6.0 x 2.7 m meeting room:

Volume V	5.5 x 6.0 x 2.7	**89.1 m³**
Total surface S	2(33) + 2(14.85) + 2(16.2)	**128.1 m²**
Untreated average absorption	Carpet, plasterboard, glass, ceiling tile	**0.10**
Untreated A	128.1 x 0.10	**12.8 sabins**
Untreated RT60	0.161 x 89.1 / 12.8	**1.12 s**
Add 20 m² at NRC 0.85	20 x (0.85 minus 0.10)	**+15.0 sabins**
Treated RT60	0.161 x 89.1 / 27.8	**0.52 s**

Twenty square metres is about 16 percent of total surface area. As a planning figure, expect to treat 20 to 30 percent of surface at NRC 0.80 or better to reach the target band.

TARGETS BY SPACE	
Huddle and small room	**0.4 to 0.5 s**
Standard meeting room	**0.4 to 0.6 s**
Boardroom	**0.4 to 0.6 s**
Training room	**0.5 to 0.7 s**
Town hall	**0.6 to 0.9 s**
Control room	**0.3 to 0.5 s**

BACKGROUND NOISE, NC RATING	
Ideal, any conferencing room	**NC-25 to NC-30**
Acceptable ceiling	**NC-35**
Typical Malaysian office room	**NC-38 to NC-45**
Usual source	**Fan coil unit**

WHY THIS COMES BEFORE THE MICROPHONE

A beamforming array improves the direct to reverberant ratio by a few decibels. Bringing RT60 from 1.1 s to 0.5 s improves it by far more, and costs less than the array. Buying the array first and the treatment never is the most common way to spend a lot of money on a room that still sounds wrong.

THE GLASS PROBLEM

Glass has an absorption coefficient around 0.03 to 0.05, so a room glazed on two or three sides has almost no absorption at speech frequencies. In order of effectiveness: an absorbent ceiling across the full area, a soft floor, a slatted or upholstered feature wall on the one solid surface you have, then heavy curtains. Film on the glass does very little for reverberation.

2.6 Treatment, isolation and the aircon

WHERE ABSORPTION ACTUALLY EARNS ITS MONEY

Absorption works on the surfaces that reflect sound back into the microphone. In a meeting room the priority order is fixed and rarely followed.

1. **Ceiling above and around the table.** The largest single reflecting surface and the one closest to both the talkers and the microphone. A mineral fibre tile at NRC 0.70 or better across the whole ceiling does most of the work in most rooms.
2. **The wall behind the display.** Sound from the loudspeakers reflects off it straight back into the ceiling array.
3. **The wall opposite the display.** The long reflection path that shows up as a distinct slap on recordings.
4. **The floor.** Carpet with underlay is worth about NRC 0.35 to 0.55 across the whole floor area, which is a large number in a small room.
5. **Side walls.** Last, and usually only needed in rooms wider than about 6 m or with parallel hard surfaces.

TYPICAL ABSORPTION VALUES FOR COMMON FINISHES

FINISH	NRC	COMMENT
Glass, glazed partition	0.03	Effectively reflective
Painted plasterboard	0.05	Reflective
Vinyl or tile floor	0.03	Reflective
Carpet with underlay	0.35 to 0.55	Cheap and effective
Standard mineral fibre ceiling tile	0.55 to 0.70	The default upgrade
High performance acoustic tile	0.85 to 0.95	Worth the difference
25 mm fabric wrapped panel	0.75 to 0.85	Good above 500 Hz
50 mm panel with air gap	0.95 to 1.00	Works down to 250 Hz

THE AIRCON IS THE NUMBER ONE NOISE SOURCE IN MALAYSIAN MEETING ROOMS

A ducted fan coil unit sitting directly above the ceiling of a small meeting room commonly measures NC-40 or worse at the table. Four fixes, in order of cost:

- Move the diffuser away from the table and the microphone position. Free at design stage.
- Increase the diffuser face area so the air moves slower for the same volume. Air noise rises steeply with face velocity.
- Add an acoustic flexible duct section, typically 1.5 to 3.0 m, between the unit and the diffuser.
- Relocate the fan coil unit out of the room entirely, over the corridor. Expensive after the fact, nearly free on a drawing.

ISOLATION BETWEEN ROOMS

Reverberation is about sound inside the room. Isolation is about sound leaving it. They need different solutions and are constantly confused.

SITUATION	TARGET
Standard meeting room to corridor	Rw 40
Meeting room to meeting room	Rw 45
Boardroom, confidential	Rw 50 or better
Divisible room moving wall	Rw 45 to 50

A partition stopping at the ceiling tile has almost no isolation whatever its rating, because sound travels over the top through the plenum. Take partitions to the slab and seal every penetration. This defeats more confidential boardrooms than any other.

HOW TO VERIFY, NOT ASSUME

Ask for a measured RT60 in octave bands from 125 Hz to 4 kHz, taken after treatment and before handover, plus a background noise measurement with the air conditioning running at normal setting. Both take about twenty minutes with a calibrated meter. Any integrator who will not do this is guessing, and so are you.

2.7 Lighting for camera, not for reading

Office lighting is designed to put light on the desk. A camera needs light on the face, which is a vertical surface. Most meeting rooms have plenty of the first and almost none of the second.

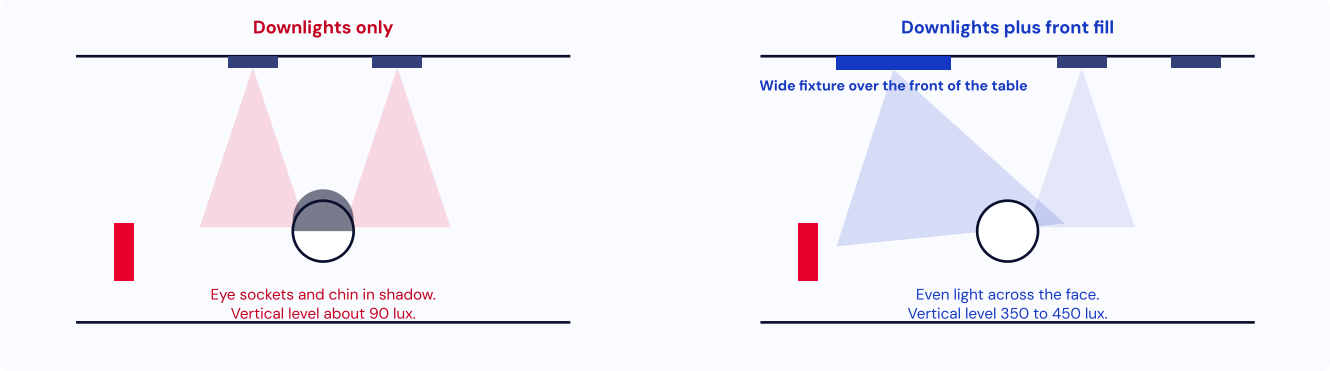


Figure 2.8 A large area luminaire placed forward of the seated position, angled back towards the faces, is the single most effective lighting change in a video conferencing room.

LIGHTING TARGETS

Vertical illuminance on face	**300 to 500 lux**
Preferred working value	**400 lux**
Horizontal on table	**300 to 400 lux**
Colour temperature	**3500 to 4000 K**
Colour rendering index	**85 minimum, 90 preferred**
Uniformity across faces	**Within 2 to 1**
Flicker	**Under 1 percent at camera frame rate**

Two different things. MS 1525:2019 gives 300 to 400 lux horizontal on the task plane and CRI 80 minimum for general offices, which is what the lighting designer already works to. The vertical illuminance and CRI 85 figures above are AV design targets for camera performance, taken from camera manufacturer and industry guidance. MS 1525 does not require them, so they have to be asked for separately.

FOUR RULES

- **Never seat anyone with a window behind them.** The camera exposes for the window and the person becomes a silhouette. If the layout cannot change, the glazing needs a blind that someone actually closes, or an automated one.
- **Use large area fixtures.** A 600 x 600 panel or a linear fixture creates soft light. Small downlights create hard shadows in eye sockets, which reads as tired on camera.
- **Keep every source the same colour temperature.** Mixing 3000 K downlights with 4000 K panels gives faces a green or magenta cast that no camera white balance can fix.
- **Zone and dim.** Presentation, video call and full brightness are three different scenes. Without scene control, someone will turn the lights off for a presentation and disappear.

HOW TO MEASURE IT IN TWO MINUTES

Hold a lux meter at the seated head position, sensor facing the camera, not facing up. That reading is what the camera sees. Do it at the seat closest to the window and the seat furthest from it. If the two differ by more than a factor of three, the room will look wrong no matter what camera you buy.

THE DISPLAY FIGHTS THE LIGHTING

Light falling on the screen washes out the image, and light behind the screen makes the bezel glare. Keep the luminaire nearest the display off the screen face, and specify a matt or anti glare panel where the room has strong daylight.

2.8 Power, containment and pathways

Every AV project that ends in exposed trunking started with a power and containment schedule that was never issued. This page is that schedule, in a form you can hand to the M&E contractor.

POWER AND CONTAINMENT SCHEDULE BY ROOM TYPE

ROOM	DISPLAY WALL	TABLE	CEILING	RACK	CONTAINMENT
Huddle	2 x 13 A behind display, plus 1 data	2 x 13 A	None	None	25 mm conduit, display to table
Small	2 x 13 A, 2 data	4 x 13 A, 1 data	None	None	32 mm conduit, display to table
Standard	2 x 13 A, 2 data	6 x 13 A, 1 data	1 x 13 A per device zone	Optional 6U	50 mm, display to table and ceiling
Large	4 x 13 A, 3 data	8 x 13 A, 2 data	2 x 13 A	9U to 12U, 2 x 13 A	Tray in ceiling, 50 mm drops
Boardroom	4 x 13 A, 4 data	Power at every second seat	2 x 13 A	12U to 18U, 4 x 13 A on its own circuit	Tray plus 50 mm drops, floor boxes
Training	4 x 13 A, 4 data	Per row as required	2 x 13 A	18U, dedicated circuit	Full tray, floor boxes at rows
LED wall	Dedicated circuits, sized to peak load	–	–	Adjacent rack room	Structural support plus tray

RULES THAT PREVENT THE TRUNKING

- **Never run AV signal cable in the same conduit as mains.** Separate containment, or a divided trunking with a metal barrier, and cross at right angles where they must meet.
- **Size conduit for the connector, not the cable.** An HDMI plug will not pull through a 20 mm conduit with a bend in it. Use 32 mm minimum for any run carrying a terminated cable, 50 mm where two or more.
- **Draw wires in every conduit at first fix.** The cheapest future proofing there is.
- **One spare Cat6a to every device position.** Two to the display wall. This costs almost nothing during the build and is the difference between a change taking an hour or a week.
- **Floor box position is dimensioned from the table, not from the wall.** If the table moves 200 mm the box is exposed.

DO NOT POWER AV FROM THE LIGHTING CIRCUIT

Rooms get lighting controls that switch circuits off out of hours. A codec that loses power every night at seven will drop off the monitoring dashboard, miss firmware windows and boot slowly when the first meeting starts. AV goes on its own circuit, always on.

EARTHING AND SURGE

A hum that no gain structure change removes is usually an earthing problem, not an equipment fault. Ask the electrical designer for protective earthing and equipotential bonding to the AV rack in accordance with the installation standard in force, a dedicated AV circuit, and surge protection at the rack. Where the equipment manufacturer calls for functional or EMC earthing, that is an additional requirement, not a substitute. All of it sits with the competent electrical designer, not with the AV contractor.

POE BUDGET IS A POWER QUESTION

Ceiling arrays, touch panels, scheduling panels, cameras and speakers are increasingly powered over Ethernet. Add up the class of every device and give the number to IT before they order the switch. A boardroom can easily need 150 W of PoE budget from a single switch, and a mid range 24 port switch may only provide 190 W in total.

A blank version of this schedule, ready to fill in per room, is on page 45.

PART THREE

Platform, display and camera

The platform decision constrains the hardware list, the display decision is arithmetic, and the camera decision is the one users will judge you on within ten seconds of the first call.

3.1
Choosing the platform

3.2
Display technology and selection

3.3
Cameras, framing and coverage

3.4
Video bar or modular system

3.1 Choose the platform before the hardware

The meeting platform decides which devices are certified, how rooms are licensed, how they are managed and what happens when a guest walks in with a different invitation. Choosing hardware first and platform second is how organisations end up with rooms that only half work.

THE FOUR WAYS A CORPORATE ROOM CAN BE BUILT

APPROACH	HOW IT WORKS	STRONGEST WHEN	THE COST PEOPLE FORGET
Native room system TEAMS ROOMS ZOOM ROOMS	A certified appliance runs the platform natively. One touch join from the room calendar, the room has its own identity and licence, and it is managed from the platform admin portal.	The organisation has standardised on one platform and wants consistency, monitoring and one touch join across many rooms.	A per room licence every year, plus the account and mailbox that goes with it.
Native plus interop	A native room system that can also join the other platform's meetings, either through a direct guest join feature or a cloud interop service.	You are standardised internally but meet external parties on other platforms constantly, which in Malaysia is normal.	Interop is often a separate subscription, and the guest experience is always a step below native.
Bring your own meeting BYOM	The room provides camera, microphone and loudspeaker as USB peripherals. The user brings a laptop and runs whatever platform the meeting is on.	Rooms used by many external visitors, agencies, project rooms, and organisations that genuinely use three or more platforms.	No one touch join, no room based monitoring, and a dependency on the user's cable discipline.
Dual mode	A native room system with a USB pass through so a guest laptop can borrow the room camera and audio for a non native meeting.	Almost every mid size Malaysian office. It is the pragmatic default.	Slightly more expensive hardware, and a switching step that needs to be obvious on the touch panel.

PUBLISHED ROOM CLASSES

These are Microsoft's published planning examples for Teams Rooms. A useful yardstick, not a joint standard, and Zoom publishes its own. Check the device against the certification list for your platform. Buying a device certified for a smaller class than your room is the most common specification error.

CLASS	ROOM	MIC TO TALKER
Focus	3.0 x 2.7 m	1.5 m
Small	4.9 x 4.9 m	2.0 m
Medium	5.5 x 6.0 m	2.4 m
Large	4.5 x 9.8 m	3.0 m

THREE QUESTIONS THAT SETTLE IT

1. What percentage of meetings in this room include someone outside the organisation? Above about 40 percent, dual mode or BYOM wins.
2. Do you want to see room health, join failures and device firmware in one dashboard? Only native gives you that.
3. Who supports the room at 9 am on a Monday? Native rooms fail in ways IT can diagnose remotely. BYOM rooms fail in ways only the person in the room can see.

LICENSING AND LIFECYCLE, THE PART THAT IS NOT ON THE QUOTATION

- One room licence per room per year, for the life of the room.
- A resource account or room mailbox, created and maintained by IT.
- Firmware updates. Decide whether they are automatic or staged, and who watches them.
- Hardware refresh at four to six years. Budget for it from year one rather than discovering it as an unplanned capital request.

3.2 Display technology and selection

Once page 15 has told you the size you need, three questions remain: which technology, how many, and what specification actually matters on a display that will run eight hours a day for six years.

CHOOSING THE TECHNOLOGY

TECHNOLOGY	USE IT WHEN	WATCH OUT FOR
Commercial LCD panel 55 to 98 in	Any room where the required image height is under about 1.25 m. This covers the great majority of meeting rooms.	Consumer televisions are cheaper and not built for 8 hour daily duty, portrait use or commercial warranty. The panel is the same, everything around it is not.
Interactive display 65 to 86 in	Training, design and workshop spaces where people genuinely write on the screen.	In a normal meeting room the touch layer is used twice and then never again. Do not pay for it by default.
Direct view LED 110 in and above	Any room where the required image height exceeds what a panel can deliver, or where a seamless wide format is wanted.	Structure, power, heat, service access and a content owner. See page 13.
Laser projection	Very large images on a budget, and rooms where the screen must disappear.	Ambient light on the screen decides it. Set a contrast target to ANSI/AVIXA V201.01, which classifies contrast by content type and measures it in the room's normal use case, then size lumens, image and screen gain to meet it. A lumens figure alone proves nothing.

THE SPECIFICATION LINES THAT MATTER

LINE ITEM	WHAT TO ASK FOR	WHY
Duty cycle	16/7 minimum, 24/7 for control rooms	Warranty depends on it
Brightness	350 to 500 nits for a normal room	Higher only if daylight is uncontrolled
Surface	Matt or anti glare	Glossy panels mirror the ceiling lights
Inputs	At least 2 x HDMI 2.0, one with CEC	Codec plus a spare for guests
Control	RS-232 or IP, plus CEC	So the room can power the screen on and off
Warranty	3 years on site, in Malaysia	Return to base on a 98 in panel is fiction

ONE DISPLAY OR TWO

Two displays are for showing content and people at the same time. That is the only good reason. A second display does not extend viewing distance and does not make text bigger. In a room under about 5 m deep, one larger display usually beats two smaller ones.

4K, AND WHEN IT IS NOT WORTH IT

Platforms send content at 1080p and often less. A 4K panel mainly buys a sharper local presentation and headroom. Worth having because it is now standard, not worth a premium.

MOUNTING AND ACCESS

- Bottom edge 1.05 to 1.20 m above finished floor.
- The wall must be reinforced. An 86 in panel with its mount is 60 to 80 kg on a partition designed for a whiteboard.
- Power and data land behind the panel, not beside it.

UNUSUAL RATIOS

21:9 ultrawide panels show a content window and a row of participants without either being tiny. Confirm the platform supports the ratio natively, or you get pillar boxes both sides.

3.3 Cameras, framing and coverage

A camera has to do two things: fit everyone in the room into the frame, and make each of them large enough to read. Wide angle solves the first and destroys the second. That tension is the whole of camera selection.

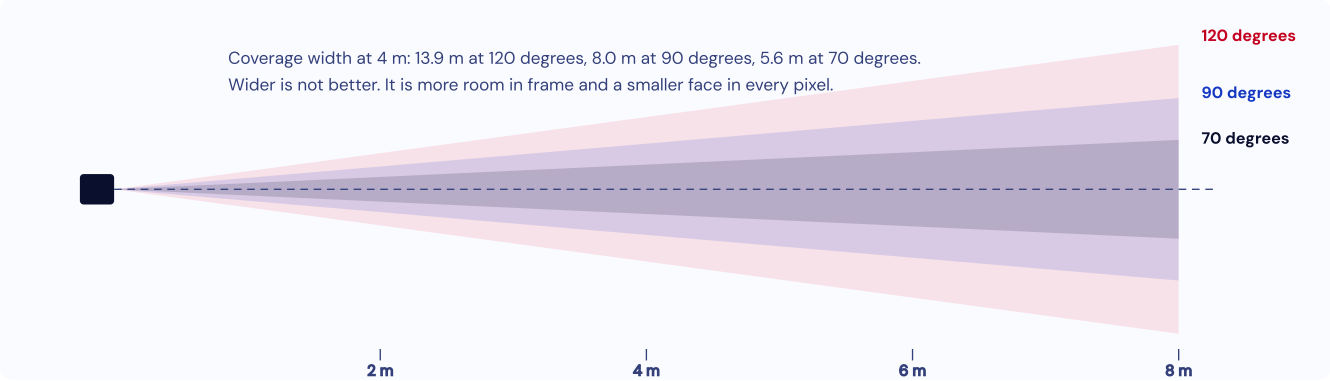


Figure 3.1 Coverage width equals 2 x distance x tan of half the field of view. Use this to check that the camera actually reaches the end seats before you rely on the marketing angle.

MATCHING FIELD OF VIEW TO THE ROOM

FARTHEST FACE	FIELD OF VIEW	CAMERA TYPE
Under 2 m	120 degrees	Fixed wide bar
2 to 4 m	90 to 120 degrees	Bar with auto framing
4 to 6 m	70 to 90 degrees	Bar or PTZ, 4x to 5x zoom
6 to 9 m	60 to 80 degrees	PTZ, 10x to 12x zoom
Over 9 m	Multiple views	Two or more cameras with a director

This table assumes a horizontal field of view, the camera centred on the display wall, and a table no wider than 1.8 m. Distance alone does not select a lens: seating width, camera position and the framing you want all change the answer, and manufacturers quote horizontal, vertical or diagonal figures interchangeably. Confirm which is quoted, then check it with the coverage formula above. Mount the lens at 1.1 to 1.5 m, seated eye level.

FRAMING BEHAVIOUR, RANKED BY HOW MUCH USERS NOTICE

- **Group framing.** The camera finds everyone and crops to fit. The safe default, and the right choice for most rooms.
- **Speaker framing.** The view cuts to whoever is talking. Excellent in a boardroom, distracting in a fast four person discussion.
- **Individual framing.** Each person is sent as their own tile, so a 6 m table looks like a gallery of separate participants. The most convincing feature of the last few years, and it needs a camera and platform that both support it.
- **Presenter tracking.** The camera follows a person moving in front of a screen. Essential in training rooms, unnecessary anywhere else.

TWO CAMERAS IS A REAL ANSWER

In a long boardroom, one camera at the display wall and a second at the far end looking back, switched by a director that follows the active microphone zone, solves the far seat problem that no single lens can. Budget for the director software or DSP logic, not just the second camera.

SPECIFICATION LINES WORTH CHECKING

- Low light performance, quoted in lux, because Malaysian meeting rooms are often dimmer than the spec sheet assumes.
- Optical zoom, not digital. Digital zoom is cropping.
- Frame rate at full resolution. Some cameras drop to 15 fps at 4K.
- Mount options. A ceiling or wall mount that suits your room, in stock, locally.

3.4 Video bar or modular system

This is the single decision with the biggest effect on both cost and outcome. The honest test is not the size of the room in square metres. It is the distance from the device to the farthest talker.

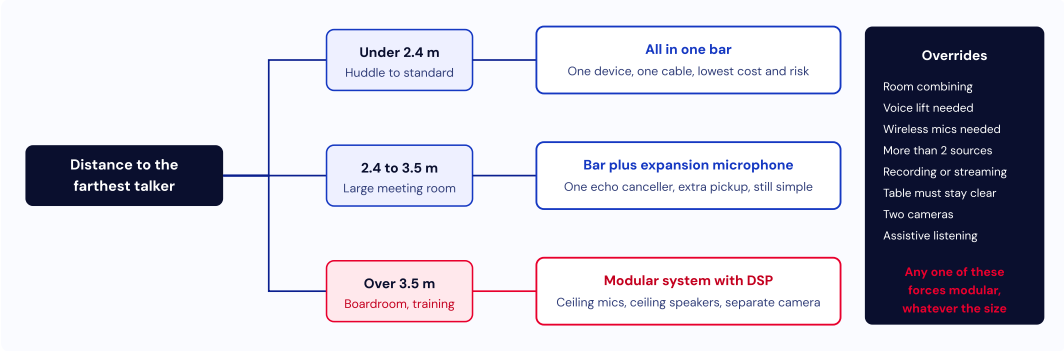


Figure 3.2 Measure from the device position to the farthest seat that people actually use, including the chairs against the wall.

WHAT THE BAR GENUINELY GIVES YOU

- **One vendor, one support call.** Firmware, echo cancellation, framing and audio tuning come from one vendor and are tested together. The trade is a single hardware failure domain: if the bar fails the room is down until it is swapped, so hold a spare across a fleet.
- **Fast, cheap installation.** A mount, a power point and a network cable. Often a day per room including commissioning.
- **Predictable rollout.** Twenty identical rooms behave identically, worth more than any single feature when you support them.

WHAT MODULAR GENUINELY GIVES YOU

- **Microphones where the people are,** not where the display is. This is the whole argument, and in a long room it is decisive.
- **Even loudspeaker coverage.** No front row too loud, no back row straining.
- **Room combining, voice lift, wireless microphones, multiple cameras, assistive listening.** These sit outside what a self contained bar is built to do, though some models accept an expansion microphone or a satellite camera. Check the specific model.
- **Component level upgrade.** The camera can be replaced without the audio.

THE SAME 4.9 X 4.9 M SMALL MEETING ROOM, SPECIFIED BOTH WAYS

LINE ITEM	BAR BASED	MODULAR
Camera and codec	All in one bar	Separate camera plus compute
Microphones	In the bar, plus one table puck	1 ceiling array
Loudspeakers	In the bar	2 ceiling loudspeakers
Indicative cost	**RM 12,000 to 20,000**	**RM 32,000 to 48,000**

Two to three times the cost, for a room where the farthest talker is 2.9 m from the bar. Modular adds a DSP, an amplifier, a rack and three to five days of ceiling coordination. At this distance the middle option, a bar with an expansion microphone, is usually the right answer.

THE UPGRADE PATH FROM A BAR IS SHORT

Vendors offer expansion microphones, satellite cameras and dual display support on some models, but beyond those the bar is replaced rather than extended. If the room might become a boardroom, or get combined with the one next door, put the containment and ceiling coordination in now even if you fit a bar today. Cabling is the part you cannot retrofit cheaply.

The option people forget sits between the two: a bar with a certified expansion microphone on the same device extends honest pickup to about 3.5 m while keeping one echo canceller.

PART FOUR

Audio, where rooms are won and lost

Microphones, loudspeakers, amplifiers and processing. This is the part of the system that decides whether the far end stays on the call, and the part that gets cut first when the quotation comes back over budget.

4.1
Choosing the microphone

4.2
Ceiling arrays and coverage

4.3
Loudspeakers and amplifiers

4.4
DSP, echo cancellation and voice lift

4.1 Choosing the microphone

Every microphone decision comes back to one ratio: how much of what reaches the capsule is the talker, and how much is the room. Distance halves that ratio faster than any processing can restore it. Doubling the distance costs you 6 dB of direct sound and gives the room the same 6 dB back.

MICROPHONE TYPES COMPARED

TYPE	WORKING DISTANCE	STRENGTHS	WEAKNESSES	USE IN
Integrated in a bar	Up to 2.4 m	Zero extra cost, zero cabling, tuned with the loudspeaker and the echo canceller by one vendor.	Fixed at the display wall, which is the worst position in any long room.	Huddle, small, standard
Table boundary or puck	0.8 to 1.2 m	Closest to the talker, so the best raw signal to noise ratio of any type. Cheap.	Picks up laptop fans, paper, tapping and bracelets. Cables in the table. People move them.	Small, standard, boardroom
Ceiling array, beamforming	1.5 to 3.0 m	Invisible, nothing on the table, steers lobes to the active talker, defines zones you can gate and mute independently.	Costs more, needs ceiling coordination, and rewards a low RT60 far more than a table mic does.	Standard, large, boardroom, training
Pendant or suspended	1.0 to 2.0 m	Gets the capsule down closer to the talkers when the ceiling is high or exposed.	Visible, needs a designed suspension, and looks improvised if not coordinated with the ID.	Exposed ceilings, high spaces
Gooseneck or delegate	0.3 to 0.5 m	Best intelligibility available. Push to talk gives explicit control of who is heard.	Formal, cluttered, and one unit per seat. Rarely right in a normal corporate boardroom.	Council chambers, formal boardrooms
Wireless handheld or lavalier	0.1 to 0.4 m	Follows the person. The only sensible answer for a presenter who moves.	Batteries, charging, frequency coordination, and someone must own them.	Training, town hall

THE RULE THAT SETTLES MOST ARGUMENTS

A table microphone at 1.0 m beats a ceiling array at 2.5 m on raw signal to noise ratio, every time. The ceiling array wins on everything else: appearance, table clutter, cable management, zone control and the fact that nobody can move it. Choose the ceiling array when those matter more, and then spend the difference on acoustic treatment so it performs.

NEVER MIX TWO SYSTEMS

One echo canceller per room. A bar plus an independent ceiling array, or a ceiling array plus a laptop with its own microphone open in the same room, produces artefacts that no setting will fix. If a room needs both a bar and ceiling pickup, the ceiling microphone must feed the bar or the DSP that already owns the loudspeaker.

WIRELESS MICROPHONE FREQUENCIES IN MALAYSIA

UHF wireless systems must operate in bands permitted by the Malaysian Communications and Multimedia Commission, and the usable spectrum has narrowed as broadcast allocations changed. Buy systems with a wide tuning range and a scan function, confirm the band with the supplier in writing, and coordinate frequencies across every system in the building rather than per room.

4.2 Ceiling arrays and coverage

A beamforming ceiling array forms narrow pickup lobes and steers them to whoever is talking. Manufacturers quote a coverage area, usually as a square at a stated ceiling height. Two things about that number are worth understanding before you rely on it.

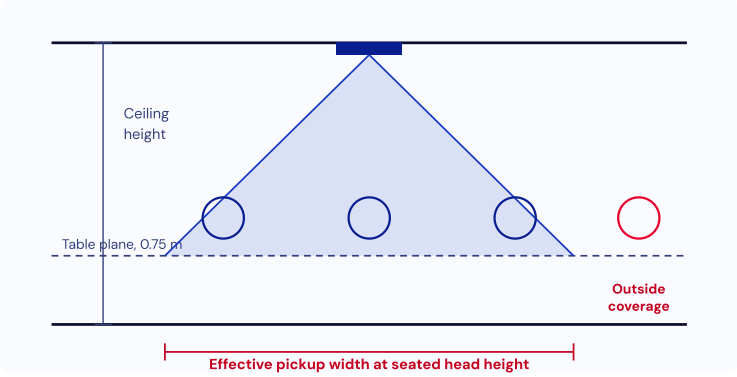


Figure 4.1 Quoted coverage is measured at a stated ceiling height. Lower the ceiling and the covered area shrinks. Raise it and the area grows but the signal weakens.

HOW MANY ARRAYS, AND WHERE

1. **Start from the seats, not the room.** Plot every seat, including wall seats, and check each is within the manufacturer's stated pickup distance from an array.
2. **Centre arrays over the table, not over the room.** The geometric centre of a room is often not the centre of the table, and the table is where the talkers are.
3. **Add an array every time the table exceeds about 4.5 m in length.** One array for a table up to 4.5 m, two up to 8 m, three beyond that.
4. **Keep arrays away from air diffusers.** A diffuser within 600 mm of an array puts moving air directly onto the capsules, which the beamformer reads as a persistent talker.
5. **Do not mount over the loudspeaker.** Keep at least 1.5 m between an array and any ceiling loudspeaker, or the echo canceller works harder than it needs to.

COVERAGE PLANNING FIGURES	
Typical quoted coverage	**9 x 9 m**
Practical pickup distance	**2.0 to 3.0 m**
Table up to 4.5 m	**1 array**
Table 4.5 to 8.0 m	**2 arrays**
Table over 8.0 m	**3 arrays**
Minimum clear depth above tile	**150 mm**
To nearest loudspeaker	**1.5 m or more**
To nearest air diffuser	**600 mm or more**

COVERAGE AREA IS NOT THE SAME AS PERFORMANCE

A quoted 9 x 9 m area means the array can form a lobe pointing at any seat in that square. It does not mean a talker at 4.5 m sounds as good as one at 2 m. Use the quoted area to check you have not run out of reach, and use the practical pickup distance to decide how many arrays you actually need.

ZONES ARE THE FEATURE WORTH PAYING FOR

Being able to define pickup zones, and exclusion zones over the doorway, the aircon and the corridor window, is what separates a good array from a cheap one. In a divisible room, zones are what let the DSP mute half the room on demand.

COMMISSIONING AN ARRAY PROPERLY

- Draw coverage zones onto the room plan, not the default square.
- Set exclusion zones over the door, corridor glazing and any diffuser.
- Walk the room talking normally and confirm every seat opens a lobe.
- Have the far end confirm it, on a real call.

THERE IS NO BIGGER ARRAY

Coverage is set by the aperture and the ceiling height, so a longer table means more arrays, not a larger one. A single device offered for a 10 m table is quoting the marketing coverage figure, not the working distance.

4.3 Loudspeakers and amplifiers

Loudspeaker layout is arithmetic, and the arithmetic is short enough to do on site. Two formulas cover every ceiling system in a corporate building.

THE TWO FORMULAS

Coverage diameter = 2 x (ceiling height minus ear height) x tan (dispersion angle / 2)

Spacing = coverage diameter x overlap factor, where the factor is 1.0 for background music, 0.7 for even coverage, and 0.5 for the smoothest level and the best speech clarity.

SPEAKER COUNT FOR A 90 DEGREE LOUDSPEAKER AT 0.7 SPACING, SEATED LISTENERS

CEILING HEIGHT	COVERAGE DIAMETER	SPACING	SPEAKERS PER 50 M²
2.7 m	3.0 m	2.1 m	12
3.0 m	3.6 m	2.5 m	8
3.5 m	4.6 m	3.2 m	5
4.0 m	5.6 m	3.9 m	4
5.0 m	7.6 m	5.3 m	2

Ear height taken as 1.2 m for seated listeners. For a standing audience use 1.7 m, which reduces the throw distance and increases the speaker count. The 0.7 factor above is the even coverage case. Speech only rooms are commonly laid out at 0.8 to 1.0, which is why the room plans in Part 2 show fewer loudspeakers than this table implies.

WORKED EXAMPLE, THE BOARDROOM ON PAGE 10

Ceiling 3.0 m, ear 1.2 m	Throw 1.8 m
90 degree dispersion	2 x 1.8 x tan 45 = **3.6 m diameter**
Spacing at 0.83 factor	**3.0 m**
Room 7.0 x 12.0 m	2 rows of 4 = **8 loudspeakers**
Tap setting for speech	8 W each
Total tapped load	64 W
Plus 20 percent headroom	**76.8 W**
Next standard amplifier size	**100 W per channel**

A 100 W channel leaves 36 W of headroom above the 64 W tapped load, which is comfortable. Confirm the amplifier is rated for the line voltage in use, that the sum of the taps stays within its rating, and that the manufacturer's own headroom guidance is met.

100 V LINE OR LOW IMPEDANCE

More than 4 loudspeakers	**100 V line**
Cable runs over 30 m	**100 V line**
Zones needed	**100 V line**
Two speakers by a screen	**Low impedance**
Short runs, high fidelity	**Low impedance**

WHY 100 V LINE FOR DISTRIBUTED SYSTEMS

A constant voltage system puts a transformer at each loudspeaker so every unit takes a set number of watts from a shared pair of wires. You can run a long loop, tap each speaker at a different power, and add one more later without recalculating impedance. It is the correct choice for almost every ceiling system in a corporate building. 100 V and 70.7 V are two distinct constant voltage standards, not two names for the same thing. The amplifier, the speaker transformer taps and the total tapped load must all be for the same one.

LEVEL TARGETS, AVIXA A104.01

Speech in a meeting room	70 to 75 dB SPL
Programme audio	80 to 85 dB SPL
Variation across the seats	Within 6 dB
Signal to noise over ambient	25 dB or better

DO NOT USE THE DISPLAY SPEAKERS

A television's built in loudspeakers fire backwards or downwards into the wall, arrive late relative to the picture, and cannot be equalised. They are acceptable in a huddle room as a fallback and nowhere else. Every room above huddle size needs loudspeakers chosen for the room.

4.4 DSP, echo cancellation and voice lift

In a modular room the DSP is the component that makes everything else work. It is also the line on the quotation that clients most often ask to remove, because it is the one box that does nothing visible.

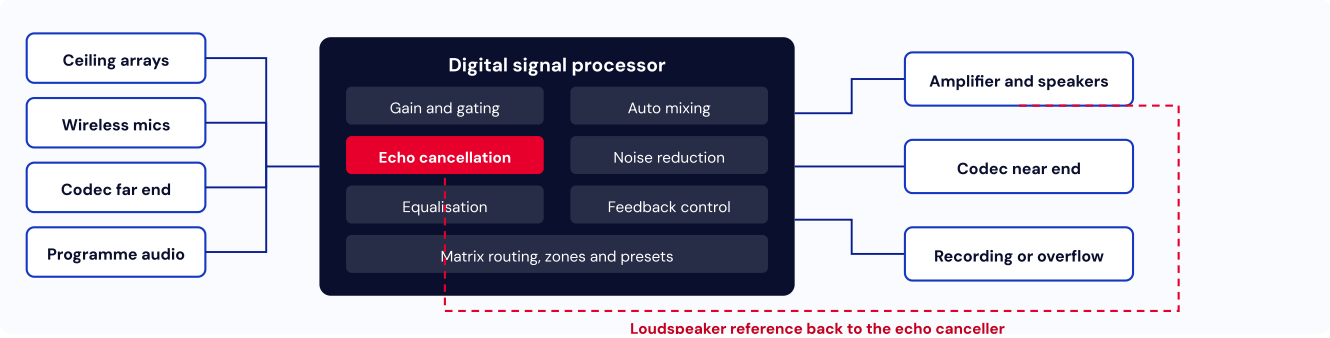


Figure 4.2 The red path is the one that matters. The echo canceller needs to know exactly what the loudspeakers are playing so it can subtract it from what the microphones hear.

WHAT ACOUSTIC ECHO CANCELLATION ACTUALLY NEEDS

- **One reference signal** that matches the loudspeaker output exactly. Anything that changes level after the reference point, including a volume knob on an amplifier, breaks it.
- **A stable room.** Every reflection is another echo path to model. This is why acoustics come first.
- **One canceller.** Two devices each trying to cancel the other is the most common cause of the artefacts users describe as robotic or clipped.
- **Time to converge.** A few hundred milliseconds at the start of every call. Users hear this as the first word being cut off, and it is normal within limits.

VOICE LIFT, AND WHEN TO USE IT

Voice lift reinforces a talker into the same room they are standing in, at a level just high enough that the back row hears them comfortably. It is a narrow line between useful and feedback.

- Target 3 to 6 dB of gain at the far seats, no more.
- Loudspeakers nearest the talker are attenuated or muted so the sound arrives from the direction of the talker.
- It needs distributed ceiling loudspeakers. A front pair cannot do it.
- Rooms shorter than about 10 m rarely need it. Rooms longer than 15 m almost always do.

WHAT TO ASK FOR AT HANDOVER

A saved configuration file, exported and given to you. The DSP credentials, handed over through your credential vault rather than in the document pack. A one page signal flow drawing. Without those three, the next change to the room means paying somebody to reverse engineer it, and if the original integrator is unavailable, replacing it.

NETWORK AUDIO

Dante and AES67 carry many channels of audio over standard Ethernet and are now the normal way to connect microphones, DSP and amplifiers in a modular room. They need a properly configured switch and, in most cases, a separate VLAN. Agree that with IT before the order, not during commissioning.

PART FIVE

Signal, control and infrastructure

Getting pictures, sound and control from where they start to where they are needed, over distances that defeat a plain cable, in a way the next person can still understand in five years.

5.1
Cables and their real limits

5.2
Matrix switching or AV over IP

5.3
Wireless presentation and BYOM

5.4
Room combining and control

5.5
Network, PoE and security

5.6
Racks, cabling and commissioning

5.1 Cables and their real limits

Almost every intermittent AV fault traces back to a cable being asked to go further than it can. The limits below are working figures for reliable installation, not the best case a manufacturer can demonstrate on a bench.

PRACTICAL DISTANCE LIMITS BY SIGNAL TYPE. LENGTHS ARE DESIGN RULES OF THUMB, NOT CERTIFIED MAXIMUMS

SIGNAL	RELIABLE DISTANCE	NOTES AND FAILURE MODE
Premium High Speed HDMI Cable 18 Gbps, 4K60	5 m	Cables are certified by category, not by HDMI version, so specify the official cable name. Certified cable often reaches about 10 m. Beyond that you get intermittent black frames and sparkle rather than a clean failure.
Ultra High Speed HDMI Cable 48 Gbps, 4K120 or 8K	3 m	Very short at full bandwidth. If the source needs it, plan for active optical from the start.
Active optical HDMI	30 to 100 m	Directional. Mark the source end. Fragile bend radius, so pull it before termination, never after.
HDBaseT Class B	70 m	Lower cost, no Ethernet channel. Fine for a simple display extension.
HDBaseT Class A, Spec 3.0	100 m	16 Gbps, carries uncompressed 4K60 4:4:4 plus control, Ethernet, USB and power on one cable. Use shielded Cat6a. Cat5e will appear to work and then fail on a hot afternoon.
USB 2.0, passive	5 m	The limit that surprises people. A camera 6 m from the codec needs an extender.
USB 3.x, passive	3 m	Shorter still. Most room cameras and bars are USB 3, so table tethers must be active.
Active USB over category cable	60 to 100 m	Confirm the extender supports the exact USB class of the device, including isochronous video.
Analogue audio, balanced	100 m and beyond	Balanced only. Unbalanced consumer audio should not leave the equipment rack.
Dante or AES67 audio	100 m per hop	Standard Ethernet rules. Needs a managed switch with the right settings.
100 V loudspeaker line	200 m and beyond	Size the conductor for the total tapped load and the run length, not by habit.

THE SINGLE CABLE TABLE TETHER

Users want one cable that carries video, USB and charging power. USB-C does all three but only over a short, high quality, correctly specified cable. Specify the cable by its certified capability, not by the connector shape, and buy a spare. It is the most handled component in the room and the first to fail.

RULES THAT PREVENT CALLBACKS

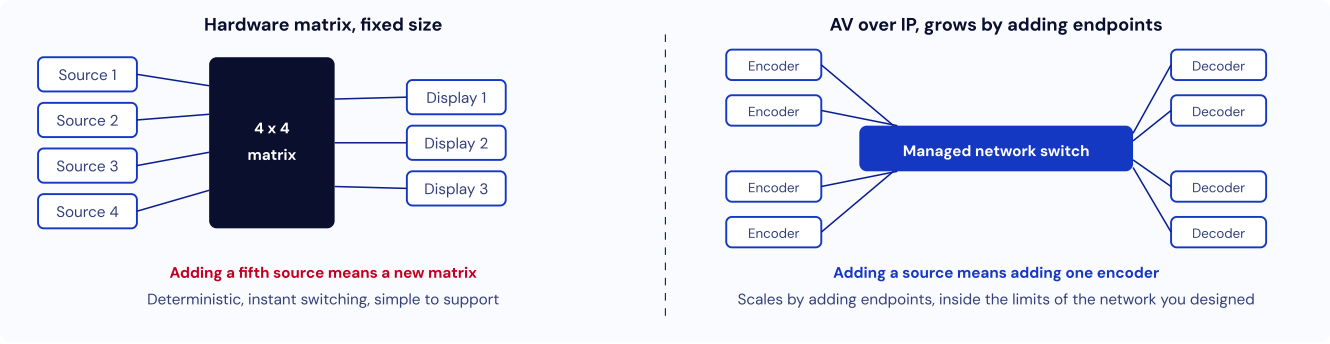
- Terminate category cable to the same standard throughout, and test every link with a certifying tester, not a continuity buzzer.
- Never join an HDMI cable with a coupler in a ceiling. Pull a new cable.
- Leave a service loop at both ends, about 300 mm.
- Keep AV cable out of mains containment.

WHAT TO WRITE INTO THE TENDER

Require category cable to meet the transport manufacturer's stated specification for the selected system, with shielding and bonding to follow that specification and the electrical design, every link certified with results handed over, and any over length run extended by an approved method rather than a longer cable. Shielded Cat6a is the usual answer for HDBaseT. It is not automatically right for every transport.

5.2 Matrix switching or AV over IP

Most meeting rooms need no switching at all. The moment a room has more than two sources or more than two displays, you are choosing between a hardware matrix and a networked video system, and the right answer depends on how much the system will change after handover.



WHICH TO CHOOSE

SITUATION	CHOOSE	WHY
One or two sources, one display	**Neither**	A direct connection or a simple auto switcher is enough. Do not buy infrastructure you do not need.
Up to 8 sources and 8 displays, in one room, unlikely to change	**Hardware matrix**	Cheaper, deterministic, instant, and it works with the network switched off.
Control room needing instant, frame accurate switching	**Hardware matrix**	Latency and switching behaviour are predictable and specified.
Sources and displays spread across floors or buildings	**AV over IP**	Point to point cabling stops being practical past one room.
System expected to grow, or a video wall with multiview	**AV over IP**	Add an endpoint rather than replace the core, within the switch fabric, uplink, multicast, port, licence and bandwidth limits you designed for.
Divisible or multi zone spaces	**AV over IP**	Zones are a software configuration rather than physical rewiring.

THE QUESTION THAT DECIDES IT

Who owns the network the AV runs on? If IT will give you a dedicated, properly configured switch with multicast handled correctly and will support it, AV over IP is excellent. If AV is going to be a guest on a general purpose network that somebody else changes without telling you, buy a matrix.

COMPRESSION, AND WHY IT MATTERS

Networked video systems differ mainly in how much they compress. Lightly compressed systems on 10 Gbps networks are visually lossless with sub frame latency and cost more. Heavily compressed systems run on 1 Gbps networks, cost far less, and add latency you can see when a presenter moves a mouse. Ask for the latency figure in milliseconds, in writing.

ASK EVERY BIDDER FOR THREE NUMBERS

- End to end latency in milliseconds, at the resolution you will use.
- Bandwidth per stream in Mbps, so IT can size the switch.
- Switching time between two sources on the same display.

THE SWITCH IS PART OF THE AV SYSTEM

Networked video needs multicast handled correctly, usually IGMP snooping with a querier, and enough backplane for every stream at once. Buying the endpoints and then asking IT to make a general purpose switch work is the most common way these projects fail.

5.3 Wireless presentation and BYOM

Wireless presentation removes the cable. Wireless conferencing goes further and lets a guest laptop borrow the room camera, microphones and loudspeakers. The second capability is worth far more than the first and is often not specified because nobody asked for it by name.

HOW THE APPROACHES DIFFER

APPROACH	HOW THE GUEST CONNECTS	STRENGTHS AND LIMITS
Hardware transmitter A dongle handed to the guest	Plug the dongle into USB-C or USB-A and press the button. No software, no network access, no account.	The most reliable path for external visitors, and the only one that works when guests cannot join your network. Dongles get lost. Buy spares and label them to the room.
Software client An app or a browser	The guest joins a network, opens the app, enters a code shown on screen.	No hardware to lose, supports several people sharing at once. Requires network access and a client install policy, which is exactly what a visitor cannot always do.
Native platform sharing	The room appears in the meeting platform and content is shared through it.	Seamless when everyone is on the same platform and useless when they are not.
Wired tether USB-C at the table	One cable that carries video, USB and charging.	Fastest and most reliable of all. Still the right primary path in most rooms, with wireless as the guest fallback.

THE CAPABILITY TO ASK FOR BY NAME

Wireless conferencing, sometimes called room USB pass through or BYOM, means the guest laptop sees the room camera and audio as if they were plugged in. Without it, a visitor running a meeting on a platform your room does not support is limited to the laptop's own camera and microphone, which defeats the purpose of the room. Confirm it explicitly, and confirm it works with your chosen camera and audio, not just in principle.

SECURITY QUESTIONS TO ASK

- Is the wireless link encrypted end to end, or does it rely on your network being trusted?
- Does the product hold recognised security certification, and can they show the certificate?
- Can it run isolated from the corporate network, on a guest VLAN or its own access point?
- Is firmware managed centrally, and what is the vendor's disclosure record?
- Does a session leave anything behind on the guest machine?

DEPLOYMENT RULES

- Put wireless presentation receivers on their own VLAN, not on the corporate user network.
- Fix the room code or name on screen so a guest can see where to connect without asking.
- Give every room the same experience. Two different systems across a floor doubles support load and halves user confidence.
- Budget one spare dongle per two rooms from day one.

THE IDLE SCREEN IS FREE MARKETING

Most systems can show a digital sign when no one is presenting. Room name, next booking, wifi guest details and the internal helpdesk number solve three small daily frustrations at no extra cost.

5.4 Room combining and control

ROOM COMBINING

A divisible space is not two rooms with a wall between them. It is one system that must reconfigure itself reliably, without a technician, every time the wall moves.

1. **Sense the wall, do not ask the user.** A partition sensor on the moving wall tells the control system the physical state. Relying on somebody pressing the right button on a panel means the room will spend half its life in the wrong mode.
2. **One DSP, multiple presets.** Each state is a stored configuration: gain structure, gating, echo canceller assignment, loudspeaker zoning and routing. The system recalls the preset, it does not improvise.
3. **Decide who owns control when combined.** One panel becomes primary, the other follows or locks. Ambiguity here produces two people fighting over the volume.
4. **Delay align the loudspeakers.** In combined mode a talker at one end reaches the far loudspeakers later than the near ones. Without delay the room sounds smeared.
5. **Test every transition, both directions.** Divided to combined and combined to divided, including mid meeting, is a commissioning test, not an assumption.

THE WALL IS THE WEAK POINT

No amount of DSP compensates for an operable wall that leaks. If the two halves must run separate confidential calls, specify Rw 45 minimum, seal it to the slab, and test it before the AV is commissioned rather than after.

CONTROL AND SCHEDULING

The control system is what the user actually touches, so it is what they judge. The best control design is the one that needs no explanation.

WHAT EACH ROOM SIZE NEEDS

ROOM	CONTROL
Huddle	None. Plug in the cable, or press the screen on the bar.
Small and standard	A single touch console on the table, showing the calendar and a join button.
Large and boardroom	Touch console plus a wall panel, source selection, volume, camera presets, lighting and blinds scenes.
Training and divisible	Full control processor, presets per mode, microphone control, and a lockable technician page.

DESIGN RULES FOR THE TOUCH PANEL

- The first screen has one obvious action: join the meeting.
- Never more than two taps to anything a normal user needs.
- Volume is a visible control, not a submenu.
- An end and reset action that returns the room to a known state.
- Advanced settings behind a code, so nobody reconfigures the room by accident.

SCHEDULING PANELS EARN THEIR PLACE

A panel at the door showing free or busy, with book now and release, solves the most common daily complaint in any office, which is rooms booked and unused. Specify PoE so it needs one cable, and confirm it integrates with your calendar system before ordering.

5.5 Network, PoE and security

Modern rooms are network devices. Everything in this chapter is IT's decision, which means it has to be agreed before the AV order is placed, not discovered during commissioning.

BANDWIDTH PER ROOM	
One video call, typical	**4 to 8 Mbps each way**
Large gallery view	**10 to 20 Mbps**
Peak with content	**30 Mbps**
Typical allowance	**20 Mbps symmetric**
Design for peak	**35 Mbps symmetric**

DSCP MARKING, MICROSOFT TEAMS	
Audio	**EF, 46**
Video	**AF41, 34**
Screen sharing	**AF21, 18**

DSCP MARKING, ZOOM DEFAULTS	
Audio	**56**
Video	**40**
Screen sharing	**40**

Two different schemes, not interchangeable. Use the current published guidance for the platform you deploy, and confirm the marks survive every hop. Marking on the room device achieves nothing if the first switch clears it.

POE BUDGET, COUNTED PER ROOM

Add up every powered device before IT specifies the switch. A single boardroom can exceed what a mid range 24 port switch delivers in total.

DEVICE	CLASS	WATTS
Ceiling microphone array	PoE+	15 to 25
Touch console	PoE+	13 to 25
Scheduling panel	PoE	7 to 13
PTZ camera	PoE+	13 to 25
Video bar	Model specific	Mains, or 50 to 90 on PoE++ models
Networked amplifier	Mains	Not PoE
Typical boardroom total		**120 to 180**

Typical, not a rule. Many video bars are mains powered, so build the real figure from the final equipment schedule. Specify the switch by total PoE budget, not per port maximum.

SEGMENTATION AND SECURITY

- **A dedicated AV VLAN.** Room devices, control processors and DSPs on their own segment, with only the ports the platform needs open outbound.
- **A separate VLAN for network audio.** Dante and AES67 are sensitive to switch configuration and should not share with general traffic.
- **Guest wireless presentation isolated** from both, so a visitor's laptop never touches the corporate network.
- **Change every default password** and record them in IT's credential store.
- **Disable unused services** on room devices, including telnet, and confirm the vendor still issues security updates for the model you are buying.

ASK ONE QUESTION BEFORE YOU SIGN

How long will this model receive firmware and security updates? A room system with a five year hardware life and two years of updates is a security problem the day the updates stop.

WHAT TO HAND IT BEFORE THE ORDER IS PLACED

ITEM	DETAIL TO SUPPLY
Device schedule	Every networked device per room, with model and PoE class.
PoE load	Total watts per room and per switch, so the switch is chosen on total budget.
VLAN request	AV VLAN, network audio VLAN where used, and isolated guest presentation.
QoS	The DSCP values above, and confirmation that marks survive every hop.

WIFI IS NOT A PLAN

Room systems on wireless work in a demonstration and fail in a busy office on a Monday morning. Every fixed room device gets a wired gigabit port. Reserve wireless for the guest laptop and the presentation path.

5.6 Racks, cabling and commissioning

THE RACK

Everything that is not in the room lives in a rack. How that rack is built decides whether a future fault takes twenty minutes or a day. ANSI/AVIXA F502.02 covers rack selection, thermal management, power and bonding, and is worth naming in the tender.

RACK SIZING AND REQUIREMENTS

ROOM	SIZE	POWER	LOCATION
Huddle, small	None or 4U wall box	1 x 13 A	Behind the display
Standard	6U to 9U	2 x 13 A	Credenza or adjacent store
Large	9U to 12U	2 x 13 A	Adjacent store
Boardroom	12U to 18U	4 x 13 A, own circuit	Adjacent store or riser
Training, divisible	18U to 24U	Own circuit plus surge	Dedicated AV room

- Leave 1U of clear space above and below any device that generates heat, and fit a fan tray if the enclosure is sealed.
- Rack mounted power distribution with individually switched outlets, not a four way strip in the bottom.
- Front and rear access. A rack pushed against a wall is a rack that gets worked on badly.
- Never put a noisy rack inside the room it serves.

LABELLING, THE CHEAPEST THING YOU WILL EVER REGRET SKIPPING

Every cable labelled at both ends with the same identifier as the drawing, to AVIXA F501.01. Every rack device labelled with its name and IP address. A laminated single line drawing inside the rack door. This costs an afternoon and saves days, for the life of the room.

COMMISSIONING IS A DELIVERABLE, NOT A FORMALITY

Witnessed and signed before the room is accepted. ANSI/AVIXA D402.02 gives the framework for choosing what to verify and against what criteria. Every test below is objective.

- RT60 measured in octave bands, against the specified target.
- Background noise measured with the air conditioning running normally.
- Loudspeaker level measured at the nearest and farthest seats, variation within 6 dB.
- Microphone pickup verified at every seat, including the wall seats.
- A real call to an external party, with the far end confirming they can hear every seat.
- Every source switched to every display.
- Every control action on the touch panel exercised.
- Room combining transitions in both directions, where fitted.
- Power cycle recovery. Unplug the rack, plug it back, confirm the room returns to a working state without intervention.

THE HANDOVER PACK

- As built drawings and a single line signal flow diagram
- DSP and control configuration files, exported
- All credentials, through a secure credential vault
- IP address schedule
- Cable test results
- Commissioning measurements
- Equipment list with serial numbers and warranty dates
- A one page user guide that fits on the wall

Withhold a meaningful portion of the final payment against the handover pack. It is the only reliable way to get it.

PART SIX

Building it in Malaysia, and what it costs

The local realities that change an AV design, indicative budget bands in ringgit for every space in this guide, and the running costs that do not appear on any quotation.

6.1
Malaysian practicalities

6.2
Budget bands in ringgit

6.3
What moves the number, and the five year cost

6.1 Malaysian practicalities

Everything in this guide applies anywhere. These are the conditions that consistently change the design, the programme or the price on projects in Kuala Lumpur, Selangor, Penang and Johor.

THE BUILDING

- **Air conditioning noise is the default problem.** Ducted fan coil units sitting directly above meeting room ceilings are near universal in Malaysian office towers, and they are the reason so many rooms measure NC-40 or worse. Raise it with the M&E consultant during design, because after handover the only remedies are expensive.
- **Ceiling voids are crowded and shallow.** Between the sprinkler main, the duct, the cable tray and the lighting, the 150 mm you need above a ceiling microphone is often not there at the position you want. Survey the void, do not trust the reflected ceiling plan.
- **T-bar grids are the norm and are your friend.** A 600 x 600 mineral fibre grid makes every device serviceable. Where the interior designer proposes flush plasterboard, get the AV device positions frozen before the board goes up, because there is no second chance.
- **Humidity is a real load.** Rooms shut over a long weekend with the air conditioning off can reach condensing conditions. Equipment in a sealed credenza has a shorter life than the same equipment in a ventilated rack.
- **Lightning and power quality.** Klang Valley thunderstorm season damages a large share of the AV equipment we replace. Specify surge protection at the rack and confirm protective earthing and bonding with the electrical designer, working to the Energy Commission installation safety code. Check the building's earthing before diagnosing hum as an equipment fault.

THE PROJECT

- **Sequencing with the interior fit out.** On most local fit outs the ID contractor leads and the AV integrator is appointed late. Insist that first fix containment, back boxes and wall reinforcement are in the ID contractor's scope with the AV integrator's drawings issued to them, or those items will be a variation.
- **Lead times.** Panels and video bars are commonly stocked locally. Fine pitch LED, large format panels above 98 in, and specialist DSP are usually indent orders with six to twelve week lead times. Order those first, not last.
- **Approvals and access.** Building management in most commercial towers requires permits to work, hot work approval for any drilling, lift bookings for large panels, and after hours access for noisy activity. Price the labour accordingly.
- **Wireless microphone spectrum.** UHF systems must be within bands permitted by the Malaysian Communications and Multimedia Commission. The usable spectrum has narrowed. Buy wide tuning range systems and coordinate frequencies building wide.
- **Equipment approvals.** Mains powered equipment sold in Malaysia should carry the appropriate certification and a three pin BS 1363 plug. Grey imports arriving with the wrong plug and no local warranty are common and are a false economy the first time something fails.

LIGHTING STANDARD TO QUOTE

MS 1525:2019 gives 300 to 400 lux on the horizontal task plane for general offices with CRI 80 minimum. That is the baseline the lighting designer already works to. Camera performance is separate: ask additionally for 400 lux vertical at seated head height and CRI 85 or better, and state it as an AV design target, because MS 1525 does not require it.

SIX QUESTIONS TO ASK BUILDING MANAGEMENT BEFORE DESIGN STARTS

1. What is the clear floor to ceiling height, and what is above the ceiling at our room positions?
2. Is the ceiling void a return air plenum?
3. Is there a riser route from this floor to the comms room, and is there spare capacity?
4. What are the working hours restrictions for drilling and coring?
5. Can we get a dedicated circuit for AV, and where is the nearest distribution board?
6. What is the goods lift capacity and the largest panel that will fit into it?

6.2 Budget bands in ringgit

Method and source. Kasturi planning estimates for the Klang Valley as at September 2026, built from our own quoted and delivered projects, current distributor pricing and published local labour rates. Not survey data, not a market study, not a quotation. The huddle, meeting room and boardroom Essential bands match the published starting prices on the Kasturi cost guide page; the other rows are extrapolated from the same project history. Excludes SST.

INDICATIVE ALL IN COST BY SPACE AND SPECIFICATION TIER

SPACE	ESSENTIAL	STANDARD	PREMIUM
Focus booth AV only, pod excluded	RM 3,000 to 6,000	RM 6,000 to 10,000	Not applicable
Huddle room 3 to 5	RM 8,000 to 14,000	RM 14,000 to 22,000	RM 22,000 to 32,000
Small meeting room 4 to 6	RM 12,000 to 20,000	RM 20,000 to 32,000	RM 32,000 to 48,000
Standard meeting room 6 to 12	RM 15,000 to 35,000	RM 35,000 to 62,000	RM 62,000 to 95,000
Large meeting room 12 to 16	RM 35,000 to 65,000	RM 65,000 to 110,000	RM 110,000 to 180,000
Boardroom 16 to 24	RM 30,000 to 80,000	RM 80,000 to 160,000	RM 160,000 to 320,000
Training room 20 to 40	RM 70,000 to 140,000	RM 140,000 to 260,000	RM 260,000 to 450,000
Divisible room 2 x 20	RM 150,000 to 260,000	RM 260,000 to 450,000	RM 450,000 to 800,000
Town hall 60 to 200	RM 180,000 to 380,000	RM 380,000 to 750,000	RM 750,000 and above
Briefing centre 10 to 20, LED based	RM 250,000 to 500,000	RM 500,000 to 950,000	RM 950,000 and above
Control room 4 to 12 operators	RM 160,000 to 320,000	RM 320,000 to 650,000	RM 650,000 and above
Lobby LED wall per m² installed	RM 9,000 to 14,000 2.5 mm	RM 15,000 to 24,000 1.5 mm	RM 24,000 to 38,000 1.2 mm

WHAT EACH TIER CONTAINS

Essential	Display, certified all in one bar or BYOD kit, mount, cables, install and basic handover.
Standard	Adds a larger or second display, expansion microphone, touch console, wireless presentation, and proper cable management.
Premium	Modular: DSP, ceiling arrays, ceiling loudspeakers, separate cameras, control processor, rack, full commissioning.

WHAT THESE FIGURES EXCLUDE

- SST
- Acoustic treatment, typically RM 250 to 600 per square metre of treated surface
- Furniture and table modification
- Builder's work: power, containment, wall reinforcement, making good
- Network switches, cabling to the comms room and IT labour
- Platform licences
- Building management charges and after hours access

WHERE THE MONEY GOES, RULE OF THUMB

Display and mounting	**20 to 30%**
Audio, mics and loudspeakers	**25 to 35%**
Camera and codec	**20 to 30%**
Switching, control, rack	**10 to 15%**
Labour and commissioning	**12 to 18%**

If audio is under 20 percent of the total, the room is underspecified for audio regardless of what the equipment list says.

6.3 What moves the number, and the five year cost

THE EIGHT THINGS THAT MOVE A QUOTATION MOST

FACTOR	EFFECT
Bar or modular	The single biggest step. Modular typically multiplies the room cost by two to four.
Display size and technology	Panel to LED is a step change, not an increment. 98 in to 136 in LED can triple the display line.
Ceiling type	Flush plasterboard adds labour and risk over a T-bar grid. Exposed ceilings add suspension design.
Acoustic condition	A glass room needs treatment a plasterboard room does not. Budget it separately and early.
Number of sources and displays	Past two of either, switching infrastructure appears in the price.
Room combining	Adds DSP capacity, partition sensing, control programming and a longer commissioning.
Builder's work in the scope	Whether power, containment and reinforcement sit with the AV contractor changes the number substantially.
Access and hours	After hours working in an occupied tower can add 20 to 40 percent to the labour line.

THE CHEAPEST LEVER NOBODY USES

Standardise. Ten identical rooms cost meaningfully less per room than ten different ones, and the saving on support over five years is larger than the saving on hardware. Decide on two or three room templates, and make every space fit one of them.

FIVE YEAR COST OF ONE STANDARD MEETING ROOM

ITEM	YEAR 1	YEARS 2 TO 5
Hardware, install, commissioning	RM 38,000	-
Acoustic treatment	RM 6,000	-
Platform room licence	RM 1,800	RM 7,200
Support and maintenance contract	Included	RM 12,800
Consumables and spares	RM 500	RM 2,000
Total	**RM 46,300**	**RM 22,000**
Five year total	**RM 68,300, or about RM 1,140 per month**	

A support contract typically runs at 8 to 12 percent of hardware value per year and buys you remote monitoring, firmware management, a defined response time and an annual health check. Rooms without one degrade quietly, and the cost shows up as meetings that start late rather than as an invoice.

CAPITAL OR OPERATING EXPENDITURE

Some organisations prefer to avoid a capital request entirely and take rooms as a monthly service, with hardware, licences, support and refresh bundled over a three to five year term.

	CAPITAL PURCHASE	MONTHLY SERVICE
Cash impact	Large, once	Level, monthly
Refresh	A new request in year five	Built into the term
Total over five years	Lower	Higher
Approval difficulty	Higher	Lower

BUDGET FOR THE REFRESH FROM DAY ONE

Room systems have a working life of four to six years, set by platform certification and security updates rather than by hardware failure. Put a refresh line in the plan in year one and the conversation in year five is routine instead of a crisis.

PART SEVEN

Tools you can use today

A site survey form, three checklists and specification text you can paste straight into a tender. Print these pages, fill them in, and send them with your enquiry. A completed survey removes about two weeks of back and forth from any AV project.

7.1
Room survey form

7.2
Readiness checklist before first fix

7.3
Power and cable schedule

7.4
Commissioning and handover sign off

7.5
Specification text for a tender document

7.1 Room survey form

One form per room. Measure, do not estimate. Where you do not know, write "unknown" rather than guessing, because a guess that turns out to be wrong costs more than an honest gap.

IDENTIFICATION

Organisation .....

Site and floor .....

Room name or number .....

Contact and mobile .....

Target completion date .....

DIMENSIONS, MEASURED

Length .....

Width .....

Clear ceiling height .....

Clear depth above ceiling .....

Display wall width .....

OCCUPANCY AND TABLE

Seats at the table .....

Additional wall seats .....

Table length and width .....

Table shape .....

Distance, display to nearest seat .....

Distance, display to farthest seat .....

Existing cable cutout .....

CEILING AND SERVICES

- [ ] Mineral fibre tile, 600 x 600
- [ ] Mineral fibre tile, 600 x 1200
- [ ] Flush plasterboard
- [ ] Exposed services, no ceiling
- [ ] Other, describe below
- [ ] Ceiling void is a return air plenum
- [ ] Air diffuser directly over the table

.....

FINISHES, FOR THE ACOUSTIC ASSESSMENT

Floor finish .....

Ceiling finish .....

Number of glazed walls .....

Curtains or blinds fitted .....

Any existing acoustic panels .....

ENVIRONMENT, MEASURED IF POSSIBLE

Background noise with aircon on, dB(A) .....

Vertical lux at seated head height .....

Window orientation .....

Is anyone seated with a window behind .....

EXISTING SERVICES IN THE ROOM

Power outlets on the display wall .....

Power outlets at the table .....

Data points, and are they live .....

Existing containment or conduit .....

Distance to the nearest comms room .....

HOW THE ROOM IS USED

Primary platform .....

Percentage of meetings with external guests .....

Content type, slides or detailed data .....

Recording or streaming needed .....

Number of sources to be shown .....

ATTACH IF YOU HAVE THEM

A floor plan with the room marked, a reflected ceiling plan, and four photographs taken from each corner. Those five items answer more questions than the whole form.

7.2 Readiness checklist before first fix

Work through this before the ceiling closes and before the M&E contractor leaves the floor. Every unticked item becomes a variation order later.

DESIGN FROZEN

- [ ] Room dimensions confirmed on site, not from drawings
- [ ] Table size, shape and position agreed
- [ ] Display size calculated from farthest viewer distance
- [ ] Display mounting height set at 1.05 to 1.20 m
- [ ] Camera position and lens height agreed
- [ ] Microphone positions marked on the reflected ceiling plan
- [ ] Loudspeaker layout calculated and marked
- [ ] Platform decided and licences ordered

STRUCTURE

- [ ] Wall reinforcement behind the display, sized to the load
- [ ] Independent slab fixings for ceiling devices
- [ ] LED wall structure signed by the structural engineer
- [ ] Rack location agreed and accessible

POWER

- [ ] AV on its own circuit, not the lighting circuit
- [ ] Outlets behind the display, quantity per the schedule
- [ ] Outlets at the table, position dimensioned from the table
- [ ] Rack power, correct quantity and circuit
- [ ] Surge protection specified at the rack
- [ ] Protective earthing and bonding confirmed to the rack
- [ ] Floor box positions set out from the table, not the wall

PATHWAYS

- [ ] Conduit 32 mm minimum, 50 mm where two or more cables
- [ ] Draw wires in every conduit
- [ ] AV containment separate from mains
- [ ] Route from room to comms room confirmed and within distance limits
- [ ] One spare Cat6a to every device position
- [ ] Two spare Cat6a to the display wall

NETWORK

- [ ] AV VLAN created
- [ ] Network audio VLAN created where applicable
- [ ] Guest presentation isolated
- [ ] Switch PoE budget confirmed against the device total
- [ ] Quality of service marking agreed end to end
- [ ] Firewall ports opened for the platform
- [ ] IP addresses reserved and documented
- [ ] Room accounts and mailboxes created

ENVIRONMENT

- [ ] Acoustic treatment specified with a measured RT60 target
- [ ] Air diffuser relocated away from the microphone position
- [ ] Lighting gives 400 lux vertical at seated head height
- [ ] Lighting scenes and dimming specified
- [ ] Blinds fitted where anyone faces a window

THE ONE ITEM MOST OFTEN MISSED

Wall reinforcement behind large displays. It has to be built into the partition, it needs several weeks of notice, and it is the difference between a clean install and a bracket bolted through plasterboard into whatever happens to be behind it.

7.3 Power and cable schedule

One sheet per room, issued to the M&E contractor at first fix. Positions are dimensioned from a stated datum. Every row is either provided by others or by the AV contractor, and the sheet says which.

POWER OUTLETS

REF	POSITION	TYPE	QTY	HEIGHT ABOVE FLOOR	CIRCUIT	BY
P1						
P2						
P3						
P4						
P5						
P6						

CABLE SCHEDULE

REF	FROM	TO	CABLE TYPE	LENGTH	CONTAINMENT	TESTED
C1						
C2						
C3						
C4						
C5						
C6						
C7						
C8						
C9						
C10						

CEILING DEVICE POSITIONS

REF	DEVICE	POSITION FROM DATUM	CLEAR DEPTH
M1			
M2			
S1			
S2			
S3			
S4			

DATUM

Datum corner used .....

Drawing reference .....

Revision and date .....

Issued to .....

TWO RULES FOR THIS SHEET

Dimension everything from one stated corner of the room, and never from the table or a partition that can move. Reissue the whole sheet with a new revision number rather than marking up an old one, because a marked up print is how two versions end up on site at once.

7.4 Commissioning and handover sign off

Every line is objective and witnessed. Do not accept the room until each is either passed or has an agreed date to be resolved.

MEASURED PERFORMANCE

TEST	TARGET	MEASURED	PASS	NOTES
RT60, 500 Hz to 2 kHz	0.4 to 0.6 s			
Background noise, aircon running	NC-35 or better			
Speech level, nearest seat	70 to 75 dB SPL			
Speech level, farthest seat	Within 6 dB of nearest			
Vertical illuminance on faces	300 to 500 lux			
Farthest viewer to image height ratio	Under 6, or under 4 for detailed content			
Cable certification results received	All links pass			

FUNCTIONAL TESTS

- [ ] Every source displays on every display
- [ ] Every microphone position verified by the far end, including wall seats
- [ ] Loudspeakers audible and even at every seat
- [ ] Camera framing correct in every supported mode
- [ ] Camera presets stored and recalled
- [ ] Wireless presentation from a guest device, no network access
- [ ] USB pass through to a guest laptop, if fitted
- [ ] Touch panel actions all functional
- [ ] Scheduling panel shows correct calendar data
- [ ] Room combining transitions tested both directions
- [ ] Volume limits set so the room cannot be driven into distortion
- [ ] Power cycle recovery, room returns to service unaided
- [ ] A live external call completed successfully

DOCUMENTATION RECEIVED, TO ANSI/AVIXA D401.01

- [ ] As built drawings
- [ ] Single line signal flow diagram
- [ ] DSP configuration file, exported
- [ ] Control system configuration file, exported
- [ ] Device credentials, via the approved credential vault
- [ ] IP address schedule
- [ ] Cable test certificates
- [ ] Commissioning measurements above
- [ ] Equipment list with serial numbers and warranty end dates
- [ ] One page user guide, laminated, in the room
- [ ] Support contact and response times, in writing
- [ ] Training delivered and attendees recorded

Accepted by, client .....

Date .....

Accepted by, integrator .....

Date .....

Outstanding items and agreed date .....

7.5 Specification text for a tender

Paste these clauses into your tender document and adjust the bracketed values. They are written to be measurable, so a bidder either meets them or has to say that they do not.

1. General

The contractor shall design, supply, install, configure, test and commission a complete audiovisual and video conferencing system for [room name], including all labour, materials, fixings, cabling, containment within the room and commissioning required for a fully working installation. Any excluded item shall be listed explicitly in the tender return. Items not listed as excluded shall be deemed included.

2. Standards

The display image size shall comply with ANSI/AVIXA V202.01:2026 for [basic] decision making viewing at the farthest viewer position of [x] metres. Sound system coverage shall comply with ANSI/AVIXA A102.01:2022 with a measured level variation across the listener area of not more than 6 dB, and spectral balance shall be assessed to AVIXA A103.01:2023 at commissioning. General lighting shall comply with MS 1525:2019. In addition, and as an audiovisual performance requirement not covered by that standard, lighting shall provide not less than 400 lux vertical illuminance at seated head height with a colour rendering index of not less than 85, measured with the sensor facing the camera position.

3. Acoustic performance

The completed room shall achieve a reverberation time of not more than 0.6 seconds averaged over the 500 Hz, 1 kHz and 2 kHz octave bands, and a background noise level not exceeding NC-35 measured with the air conditioning operating at its normal setting. The contractor shall measure and report both values before handover. Where the room as built does not meet these values, the contractor shall advise the acoustic treatment required.

4. Audio

Microphone coverage shall be provided such that every seated position, including seats not at the table, is within [2.4] metres of a microphone element. A single acoustic echo canceller shall serve the room. Loudspeakers shall be distributed so that no listener position falls outside the overlapping coverage of at least one device at seated ear height of 1.2 metres.

5. Cabling and infrastructure

Category cabling serving audio visual systems shall meet or exceed the requirement stated by the manufacturer of the selected transport system, including category, shielding, termination and bonding, and shall be coordinated with the electrical design. Where HDBaseT is used, shielded Cat6a or better shall be provided. Every link shall be certified with results submitted at handover. No signal cable shall exceed the manufacturer's stated distance limit. Signal cabling shall not share containment with mains cabling. All cables shall be labelled at both ends with identifiers matching the as built drawings.

6. Network

The contractor shall submit, within [10] working days of award, a schedule of all network requirements including device count, PoE class and total PoE load per room, required VLANs, IP address requirements, firewall ports and quality of service marking, for approval by the client's IT function.

7. Commissioning

The contractor shall carry out and record the commissioning tests listed in the client's commissioning schedule, in the presence of the client's representative, following the verification framework of ANSI/AVIXA D402.02. The system shall not be deemed complete until all tests are passed or an agreed rectification date is recorded for each outstanding item.

8. Handover and documentation

Documentation shall follow ANSI/AVIXA D401.01. The contractor shall provide as built drawings, a single line signal flow diagram, exported configuration files for all programmable devices, an IP address schedule, cable test certificates, commissioning measurements, an equipment list with serial numbers and warranty expiry dates, and a one page user guide. Device credentials shall be transferred separately through the client's approved credential vault or an equivalent secure handover process, and shall not be included in the documentation pack. Retention of [10] percent against acceptance of this documentation is proposed; confirm the retention and payment terms with your own legal and procurement team before issuing.

9. Support

The tender return shall state the warranty period and whether it is on site or return to base, the support response time in business hours, the escalation path, and the annual cost of a support contract as a percentage of hardware value.

A The standards this guide is built on

AVIXA publishes the performance standards that turn "it should look and sound good" into something you can measure and put in a contract. Most are ANSI accredited. None are free, and all are cheap next to a room that fails acceptance.

PUBLISHED AVIXA STANDARDS RELEVANT TO A CORPORATE MEETING ROOM, AS AT SEPTEMBER 2026

STANDARD	WHAT IT DEFINES	HERE	USE IT TO
V202.01:2026 ANSI/AVIXA Display Image Size, DISCAS	Image size and viewing positions, derived from the smallest element that has to be read.	2.4, p15	Settle display size on evidence, not on what fits the wall.
V201.01:2021 ANSI/AVIXA Image System Contrast Ratio	Contrast ratio and its measurement, in four categories set by content type, measured in the room's normal use case.	3.2, p23	Specify a projector or LED wall by measured performance, not by a lumens figure.
A102.01:2022 ANSI/AVIXA Audio Coverage Uniformity	How evenly a sound system covers the seats, and how to measure it.	4.3, p29	Put a measurable coverage requirement in the tender.
A103.01:2023 AVIXA Sound System Spectral Balance	Tonal balance at design and at commissioning.	5.6, p37	Define what "it sounds right" means before you sign.
A104.01 AVIXA Dynamic Range	Required sound pressure level and recommended signal to noise ratio by venue type.	4.3, p29	Back the level targets with a published source.
F502.02:2020 (R2023) ANSI/AVIXA Rack Design	Rack selection, ventilation and thermal management, power, earthing and bonding.	5.6, p37	Stop racks being designed by whoever has the drill.
F501.01:2015 AVIXA Cable Labeling	Labelling that keeps a system maintainable after the installer leaves.	5.6, p37	Make labelling a deliverable, not a favour.
D401.01:2023 ANSI/AVIXA Documentation Requirements	What documentation a project produces, who creates it, how delivery is tracked.	7.4, p46	Define the handover pack so it cannot be argued about.
D402.02:2013 (R2024) ANSI/AVIXA Performance Verification	A framework for what gets verified, against what criteria, by whom.	7.4, p46	Make commissioning a pass or fail event with a witness.

Two others are worth knowing without being covered here. **S601.01:2021** deals with ongoing energy management across an AV estate, relevant if you report on building energy. **TR-111:2019** is a technical report rather than a standard, and is background reading before a smart building tender.

HOW DISCAS ACTUALLY WORKS

The 4 and 6 image height ratios on page 15 are a simplification. The standard sizes a display from the smallest thing that must be readable on it.

- **Basic decision making** works from percent element height. Presets in common use are around 3 percent for lecture slides, 2 percent for financials, 1.5 percent for dense spreadsheets.
- **Analytical decision making** replaces that with the display's vertical pixel resolution, because at that detail the pixel is the limit.

FREE TOOLS WORTH USING

AVIXA publishes DISCAS calculators at no cost. Enter the farthest viewer distance and the element height and it returns the minimum image height, or work backwards from a display you already own.

It also publishes free quizzes on several of these standards, a quick way to test whether a bidder knows the material they are citing.

HOW TO CITE THEM IN A TENDER

Name the standard, the edition and the performance you require, then say who measures it and when. "Compliant with AVIXA standards" is meaningless and every bidder will tick it. "Coverage verified to ANSI/AVIXA A102.01:2022, level variation across the seats not more than 6 dB, witnessed before handover" is a requirement somebody either meets or does not.

TWO WAYS TO USE WHAT YOU HAVE JUST READ

Get your room assessed, or design it yourself first

FREE ROOM ASSESSMENT AND SITE VISIT

Send us the completed survey form from page 43, or just tell us the room. We will visit, measure the things that actually decide the outcome, and come back with a room design and an itemised quotation.

- Measured dimensions, sightlines and microphone distances
- Background noise and reverberation assessed on site
- Ceiling and power readiness checked before you commit
- Itemised quotation with exclusions stated in writing

START ONLINE, IN ABOUT FOUR MINUTES

Answer four questions about the room and get an indicative design and budget before you speak to anyone. Useful when you need a number for a budget submission this week.

Room designer
kasturi.com.my/room-designer/

What a system costs in Malaysia
kasturi.com.my/how-much-does-a-video-conferencing-system-cost-in-malaysia/

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COVERAGE

Kuala Lumpur, Selangor,
Johor Bahru, Penang, Perak,
Melaka, Pahang, Sabah, Sarawak

This guide is vendor neutral. Brands are named as worked examples where they illustrate a class of product. Figures are indicative planning values for the Klang Valley as at September 2026 and do not constitute a quotation. Standards are cited by reference and should be read in full before being used contractually. © 2026 Kasturi Technology.