

RESTREPO STANDARD

Pathway. Power. Provision.

Pre-Rack AI Standard

Conduit · Power · Cooling · VLAN · Rack · QC

The room hears. The room understands. Nothing leaves the room.

00

PREFACE

The AI appliance does not arrive on a Restrepo project as a surprise. Conduit, power, cooling, network, and rack provisions are pulled, sized, and labeled before the rack arrives. This standard codifies what is in the wall, in the panel, and in the rack room before the AI box ever ships. Nine sections cover the pre-arrival pathway: conduit and pathway, power and circuit, cooling and acoustics, network and VLAN provisions, rack and mount, audio capture rough-in, control bridge prep, without-written-direction, and the pre-arrival checklist. The QC gate is the closeout signature that the room is ready.

This standard does not replace manufacturer instructions, code authorities, or professional licensing. NEC 2023 (NFPA 70), NJ residential code amendments, Apple Mac Studio thermal documentation, Sennheiser TCC 2 and Shure MXA920 installation guides, and Lutron / Crestron / Control4 integration documentation govern. See Citations for primary source URLs.

The room hears. The room understands. Nothing leaves the room.

Pre-rack discipline is the floor. The standard is the ceiling.

01 CONDUIT & PATHWAY

Every AI VLAN homerun, audio capture homerun, and control bridge pathway is pulled before the appliance arrives. Restrepo's pull discipline includes labeled both-end terminations, spare smurf tubes with pull strings, and pathway separation per NEC 800.133.

AI VLAN homerun

1" EMT or 3/4" smurf tube from rack location to network closet. One Cat6A pulled, one spare smurf left in place. Label both ends RED 'AI-VLAN'.

Audio capture homeruns

3/4" smurf tube per ceiling mic location to rack. Sennheiser TCC 2 on Dante: Cat6A. Shure MXA920: Cat6A PoE+. Pull spare per location. Label by mic ID.

Control bridge pathway

Dedicated 3/4" smurf tube from AI rack to Crestron / Lutron / C4 processor location. Cat6A pulled, terminated at both ends to keystone.

Out-of-band access path

1/2" smurf tube to a head-end-only KVM or Tailscale relay (if approved). For Tier 1 boardroom, plan for an air-gapped local console only.

Spare pathway reservation

One spare 3/4" smurf tube reserved at AI rack location for future RTX 4090 expansion or second Mac Studio. Pull string left in place.

Pathway separation

AI VLAN pathways separated from line-voltage by NEC 800.133 spacing minimums. No shared raceway with 120V or 277V branch circuits.

SPEC · PATHWAY SEPARATION

AI VLAN pathways are separated from line-voltage by NEC 800.133 spacing minimums. No shared raceway with 120V or 277V branch circuits. Both pathway types may share a closet but never a single conduit.

02

POWER & CIRCUIT

Tier 1 AI appliances receive a dedicated 20A 120V circuit on UPS. Tier 2 and Tier 3 may share a UPS branch with low-draw equipment. Surge protection is mandatory at the service panel and at the rack receptacle.

TIER	PLATFORM	WATTS	CIRCUIT	RECEPT.	NOTES
Tier 1	Mac Studio M2 Ultra (192 GB)	295 W max, 10 W idle	Dedicated 20A 120V on UPS	NEMA 5-20R	M2 Ultra max documented at 295 W; 370 W max continuous spec ceiling. Quiet under load.
Tier 1 alt	RTX 4090 in 2U workstation	450-493 W under load, ~80 W idle	Dedicated 20A 120V on UPS	NEMA 5-20R	Plan thermal isolation. Consider 240V for headroom on multi-component build.
Tier 2	Mac Mini M4 Pro (64 GB)	~140 W max, 6-7 W idle	Shared 15A 120V on UPS	NEMA 5-15R	Mac Mini accepts 100-240V; can share circuit with low-draw equipment.
Tier 3	Mac Mini M4 base (16 GB)	~85 W max, 4-5 W idle	Shared 15A 120V on UPS	NEMA 5-15R	Transcription-only add-on; minimal load.

UPS, SURGE, AND POWER DISCIPLINE

- UPS sizing: Tier 1 minimum 1500 VA / 980 W online double-conversion (e.g., APC SUA1500RM2U class). Runtime 10+ minutes at full load.
- Tier 2/3: 1000 VA line-interactive acceptable. Always pair with surge-protected receptacle on the AI side of the UPS.
- Network gear (AI VLAN switch, control bridge) on the same UPS branch as the AI appliance. No mixed UPS branches.
- AI appliance must auto-restart on AC restore; configure System Settings or BIOS to power-on on AC apply.
- Surge protection: Type 1 SPD at service panel + Type 3 plug-in SPD at rack receptacle. Both required for warranty and code compliance.

03

COOLING & ACOUSTICS

Mac Studio is silent. RTX 4090 is not. Rack room thermal envelope and acoustic isolation are designed before the appliance ships. Ambient temperature is held between 65 and 75 F at rack inlet for sustained inference performance.

PLATFORM	POWER MAX	BTU/H	ACOUSTIC	MOUNT / NOTES
Mac Studio M2 Ultra	295 W max	1,007 BTU/h max	6 dBA idle	Vented 3U Sonnet xMac shelf; ambient under 95 F (35 C); rear clearance 4 in min.
Mac Mini M4 Pro	140 W max	478 BTU/h max	Inaudible at 1 m	Vented 1U shelf or recessed niche; ambient under 95 F; rear clearance 2 in min.
RTX 4090 2U workstation	493 W max	1,683 BTU/h max	30-45 dBA under load	Acoustic isolation cabinet required if shared with audio rack; front-to-back airflow path.
AI VLAN switch (16-24 port PoE+)	150-300 W typical	510-1,023 BTU/h	Variable	Standard 1U; rear-exhaust models preferred; do not block by patch panel cable bundles.

COOLING DISCIPLINE

- Rack room ambient: maintain 65-75 F (18-24 C) at rack inlet. Above 80 F, M-series Mac throttles; RTX 4090 throttles above 84 C die temp.
- Boardroom-adjacent rack: acoustic isolation required. Mac Studio is silent; RTX 4090 is not. If RTX 4090 used, rack room is not the boardroom.
- Closet ventilation: passive vent grille high and low; or active 80 mm fan exhaust controlled by thermostat at 78 F setpoint.
- No spinning-disk drives on the AI rack. Mac Studio and Mac Mini are SSD-only by spec; RTX 4090 build uses NVMe boot + SATA SSD storage.
- Cable management dictates airflow: use horizontal cable managers; do not zip-tie patch cables across an exhaust port.

04 NETWORK & VLAN PROVISIONS

The AI VLAN is a dedicated, firewalled segment. WAN egress is denied. Internal DNS, internal NTP, and an internal TLS certificate authority govern the segment. Validation is required before commissioning.

AI VLAN ID

Reserve a dedicated VLAN ID (recommended VLAN 15 in Restrepo numbering convention). No DHCP relay to client VLAN. No inter-VLAN routing except through the control bridge ACL.

Switch capability

Managed PoE+ switch at the rack: minimum 8 ports gigabit, 4 PoE+ for ceiling mics. Recommended 24-port multi-gig with 4x 10G uplinks for Tier 1 build with multiple capture devices.

Firewall rules

WAN egress DENY on AI VLAN. DNS internal only (Pi-hole, pfBlockerNG, or AdGuard Home). NTP internal only or via trusted internal NTP server. mDNS scoped to VLAN.

Control bridge ACL

Only Crestron, Lutron, and Control4 processor IP addresses are permitted to POST to AI appliance ports. All other source addresses dropped at firewall.

Telemetry blocking

DNS blocklist includes Apple analytics, Microsoft telemetry, and any model vendor domain. Validate by attempting curl from AI appliance: should time out.

Internal TLS

Open WebUI served via internal TLS. Self-signed CA generated at commissioning, distributed to client devices. No Let's Encrypt; no public DNS.

Validation

From every other client VLAN, ping AI appliance IP must fail. From AI appliance, curl https://example.com must time out. Document both tests in QC log.

INSPECT · VLAN VALIDATION TESTS

From every other client VLAN, ping AI appliance IP must fail. From AI appliance, curl https://example.com must time out at the firewall. Both tests documented in the QC log with timestamps.

05 RACK & MOUNT

Tier 1 Mac Studio mounts in a 3U Sonnet xMac Studio Pro enclosure. Tier 2/3 Mac Mini sits on a 1U Middle Atlantic UTR1 utility shelf. RTX 4090 builds receive an acoustic isolation cabinet if co-located with audio rack equipment.

3U Sonnet xMac Studio Pro

PCIe expansion enclosure for Mac Studio; up to 3 PCIe slots via Echo III; mounts in standard 19-inch rack.

1U Middle Atlantic UTR1 utility shelf

10-inch depth, 25 lb capacity. Suitable for Mac Mini Tier 2/3 placement.

Custom Legrand AV U Series Utility Rackshelf

Wider footprint shelves for Mac Studio if Sonnet enclosure is not specified. Confirm 7.7-in footprint clearance.

Acoustic isolation cabinet

Required for RTX 4090 builds in audio-adjacent rack. Front-to-back airflow with intake and exhaust filters.

Cable management

1U horizontal manager above and below AI appliance; vertical manager in rear for power and patch cables; service loop at every cord end.

Labeling

Front label: 'AI APPLIANCE / VOL 15 / Tier [N] / [Date]'. Rear label per cord: source, destination, VLAN.

Velcro-wrapped service loops.

06 AUDIO CAPTURE ROUGH-IN

Ceiling mic backbox cuts, Cat6A pulls, and PoE+ provisions are placed before the mic ships. The DSP gates AI capture path on consent signal only. A consent indicator LED at mic location shows occupants when AI is listening.

Sennheiser TeamConnect Ceiling 2 (509161)

Pull Cat6A to mic location; Dante on AI VLAN; PoE+ from AI rack switch; mounting backbox per Sennheiser drawing 509161-001.

Shure MXA920

Pull Cat6A to mic location; Dante/AES67 on AI VLAN; PoE+; ceiling tile cutout per Shure ceiling array installation guide.

Shure MXA710

Pull Cat6A; PoE+; linear ceiling or wall mount per Shure MXA710 datasheet; verify finish coordination with architect.

Biamp Parlé TCM-XA

Pull Cat6A to mic; AVB or Dante to TesiraFORTE DSP; backbox per Biamp installation; integrate into existing DSP.

Mic placement zone

Confirm with calibration tech (Vol 13): mic centerline aligned with conference table center; clearance from ceiling diffuser; no reverb-source proximity.

Consent indicator

Plan for a small green/red LED indicator at mic location showing 'AI listening' state. Driven from AI appliance via DSP GPIO or control system feedback.

07

CONTROL BRIDGE PREP

Crestron, Lutron, and Control4 control bridge pathways are pulled and authentication credentials provisioned at commissioning. Every spoken control intent passes a confirmation step. A dedicated kill switch hardwires capture mute and intent disable.

Crestron 4-Series

Dedicated Cat6A from AI rack to Crestron processor location. Plan for SIMPL# Pro program update at commissioning. EISC channel reserved for AI bridge signals.

Lutron HomeWorks

Dedicated Cat6A to Lutron processor. LIP Telnet (port 23) or LEAP API authentication credentials provisioned at commissioning. Document integration ID table.

Control4 EA-3 / EA-5

Dedicated Cat6A to Control4 controller. DriverWorks .c4i driver loaded at commissioning. Composer Pro project file updated and re-deployed.

Confirmation gate

Every spoken control intent passes a confirmation step before live execution. No autonomous commits. Plan for an acknowledgment tone within 500 ms.

Latency budget

STT 200-400 ms + LLM 500-800 ms + intent 50 ms + scene 100-200 ms = ~950-1,650 ms total. Acknowledgment tone covers perceived latency.

Kill switch

A dedicated kill-switch button on the room control panel mutes AI capture and disables all control bridge intents. Wired to a hard GPIO; not software-only.

08 WITHOUT WRITTEN DIRECTION

Seven actions do not occur on a Restrepo Vol 15 project without written direction from the Restrepo principal. Written direction means a signed project record entry, a documented principal authorization, or a formal client contract clause.

We do not run AI in the conference room without written direction:

- 1 We do not run AI in the conference room without written direction: ship an AI appliance to a job site without conduit, power, cooling, and VLAN provisions in place.
- 2 We do not run AI in the conference room without written direction: tap an existing shared circuit for AI appliance power. AI gets a dedicated 20A 120V circuit on UPS.
- 3 We do not run AI in the conference room without written direction: route AI appliance traffic on the client VLAN. The AI VLAN is a dedicated, firewalled segment.
- 4 We do not run AI in the conference room without written direction: connect the AI appliance to the WAN. WAN egress is denied at the firewall on the AI VLAN.
- 5 We do not run AI in the conference room without written direction: install a fan-noisy GPU build (RTX 4090) in a boardroom-adjacent rack without acoustic isolation.
- 6 We do not run AI in the conference room without written direction: defer rack labeling to closeout. Front and rear labels are placed at install, not at QC.
- 7 We do not run AI in the conference room without written direction: substitute a smaller UPS than spec. Tier 1 UPS is 1500 VA online double-conversion minimum.

09

PRE-ARRIVAL CHECKLIST

Every item below is verified before the AI appliance ships to the job site. Any unchecked item holds delivery until remediated. The pre-arrival checklist is the gate.

- ☐ Pathway pulled and labeled: AI VLAN homerun, audio capture homeruns, control bridge pathway, OOB access path, spare pathway reservation
- ☐ Power: dedicated 20A 120V circuit on UPS for Tier 1; UPS sized to spec; surge protection Type 1 + Type 3 in place
- ☐ Cooling: rack room ambient 65-75 F at inlet; passive or active vent installed; thermostat setpoint at 78 F if active
- ☐ Network: AI VLAN configured on managed switch; firewall rules (WAN deny, DNS internal, NTP internal) applied; control bridge ACL written
- ☐ DNS: telemetry blocklist active and validated; curl test from AI appliance to public URL times out
- ☐ Rack: 3U Sonnet (Tier 1) or 1U shelf (Tier 2/3) installed; cable management above and below; service loops on every cord
- ☐ Audio capture: ceiling mic locations cut, backboxed, Cat6A pulled and tested; consent indicator wired
- ☐ Control bridge: Cat6A to Crestron / Lutron / Control4 processor pulled and terminated; integration credentials provisioned
- ☐ Kill switch: hardwired to room control panel; GPIO tested; mutes capture and disables intents
- ☐ Labels: rack front and rear labels placed; cord labels at both ends; mic IDs labeled at termination

QC

QC GATE · 10-ITEM PRE-RACK PASS/FAIL

All 10 items must be PASS before the AI appliance ships to the job site. Every item is reviewed by the project lead. Any failed item holds delivery until resolved.

#	QC GATE ITEM	PASS	FAIL
1	Conduit and pathway pulled and labeled Every required pathway pulled to spec. Cat6A tested. Smurf tubes with pull strings. Both-end termination.	PASS / SIGN	FAIL / HOLD
2	Dedicated AI circuit on UPS verified Tier 1: 20A 120V dedicated circuit on UPS. Tier 2/3: shared circuit acceptable on UPS. Surge protection Type 1 + Type 2.	PASS / SIGN	FAIL / HOLD
3	Cooling and acoustics verified Rack room ambient 65-75 F at inlet. Boardroom-adjacent rack acoustically isolated if RTX 4090 build. Vent grilles or active cooling.	PASS / SIGN	FAIL / HOLD
4	AI VLAN configured and firewalled VLAN ID assigned. WAN egress deny rule active. DNS internal only. NTP internal only. Control bridge ACL applied.	PASS / SIGN	FAIL / HOLD
5	Telemetry blocking validated DNS blocklist active. curl from AI appliance to public URL times out.	PASS / SIGN	FAIL / HOLD
6	Rack and mount in place to spec Sonnet xMac (Tier 1) or 1U shelf (Tier 2/3) installed. Cable management above and below.	PASS / SIGN	FAIL / HOLD
7	Audio capture rough-in complete Ceiling mic backboxes cut. Cat6A pulled and tested to mic location. Consent indicator installed.	PASS / SIGN	FAIL / HOLD
8	Control bridge pathway and credentials provisioned Cat6A to Crestron / Lutron / Control4 processor pulled. Integration credentials provisioned and stored in secure location.	PASS / SIGN	FAIL / HOLD
9	Kill switch hardwired and tested Hardwired to room control panel via GPIO. Mutes AI capture and disables control bridge intents.	PASS / SIGN	FAIL / HOLD
10	Labels placed at install Rack front and rear labels in place. Every cord labeled at both ends. Mic IDs labeled at termination.	PASS / SIGN	FAIL / HOLD

PROJECT LEAD SIGN-OFF

Signature / printed name

DATE

MM/DD/YYYY

PROJECT

REF CITATIONS & PRIMARY SOURCES

- 1 **Apple Mac Studio M2 Ultra Technical Specifications**
Apple Support primary source for M2 Ultra hardware specs, power consumption, thermal output, acoustic performance.
<https://support.apple.com/en-us/111835>
- 2 **Apple Mac Studio Power Consumption and Thermal Output**
Apple Support reference for Mac Studio continuous power, idle power, BTU/h thermal output.
<https://support.apple.com/en-us/102027>
- 3 **Apple Mac Mini M4 Pro Technical Specifications**
Apple primary source for Mac Mini M4 Pro CPU, GPU, memory, bandwidth, and power.
<https://www.apple.com/mac-mini/specs/>
- 4 **Sonnet xMac Studio Pro 3U Rackmount Enclosure**
Sonnet primary product page for 3U rack enclosure with Echo III PCIe expansion. Mounting reference.
<https://www.sonnetstore.com/products/xmac-studio>
- 5 **Middle Atlantic / Legrand AV U Series Utility Rackshelf**
Legrand AV primary source for utility rackshelves used for Mac Mini placement.
https://www.legrandav.com/products/accessories/rackmount_shelves/u_utility_rackshelf
- 6 **Sennheiser TeamConnect Ceiling 2 (509161) Product Page**
Sennheiser primary source for TCC 2 specifications, mounting, Dante connectivity.
<https://www.sennheiser.com/en-us/catalog/products/meeting-and-conference-systems/teamconnect-ceiling-2/teamcon...>
- 7 **Shure MXA920 Ceiling Array Microphone Documentation**
Shure primary source for MXA920 ceiling array, IntelliMix DSP, Dante/AES67, ceiling tile cutout dimensions.
<https://www.shure.com/en-US/products/microphones/mxa920>
- 8 **Shure MXA710 Linear Array Microphone Documentation**
Shure primary source for MXA710 specifications and mounting reference.
<https://www.shure.com/en-US/products/microphones/mxa710>
- 9 **Biamp Parle TCM-XA Datasheet**
Biamp primary source for TCM-XA Beamtracking ceiling microphone with onboard amplifier.
https://downloads.biamp.com/assets/docs/default-source/data-sheets/biamp_data_sheet_parle_tcm-xa_nov25b.pdf
- 10 **NVIDIA GeForce RTX 4090 Product Page (Ada Lovelace)**
NVIDIA primary source for RTX 4090 specifications, TDP, VRAM, thermal envelope.
<https://www.nvidia.com/en-us/geforce/graphics-cards/40-series/rtx-4090/>
- 11 **Crestron Developer Tools Portal**
Crestron primary source for SIMPL# Pro, REST API for Crestron Home OS, EISC documentation.
<https://sdkcon78221.crestron.com>
- 12 **Lutron Integration Protocol Guide (LIP, Document 040249)**
Lutron primary source for LIP Telnet protocol over TCP port 23. #OUTPUT command syntax.
<https://assets.lutron.com/a/documents/040249.pdf>
- 13 **Lutron LEAP API Integration Protocol Documentation**
Lutron primary source for LEAP API (preferred for new builds, replaces LIP).
<https://support.lutron.com/us/en/product/homeworks/article/networking/Lutron-s-LEAP-API-Integration-Protocol>
- 14 **Control4 DriverWorks SDK Repository**
Control4 primary source for Lua-based driver development; .c4i driver format; Composer Pro deployment.
<https://github.com/snap-one/docs-driverworks>
- 15 **NEC 2023 (NFPA 70) Article 800 · Communications Circuits**
NFPA 70 primary source for Article 800 governing communications circuits and pathway separation rules.
<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70>

REF

CITATIONS & PRIMARY SOURCES (CONT.)

16

APC by Schneider Electric · Smart-UPS SUA1500RM2U

APC primary source for online double-conversion UPS sizing reference for Tier 1 AI rack power.
<https://www.apc.com/us/en/product/SUA1500RM2U/>

17

Ollama GitHub Repository (MIT)

Ollama primary source for local model server REST API on localhost port 11434.
<https://github.com/ollama/ollama>

18

Whisper.cpp GitHub Repository (MIT)

Whisper.cpp primary source for Core ML build on Apple Silicon Neural Engine.
<https://github.com/ggml-org/whisper.cpp>

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N.J.S.A. 2A:156A-3 · New Jersey One-Party Consent

Justia primary source for NJ one-party consent for audio recording. Restrepo posture: signage and verbal consent.
<https://law.justia.com/codes/new-jersey/title-2a/section-2a-156a-3/>

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California Penal Code § 632 · Two-Party Consent

California primary source for all-party consent for confidential communications.
<https://www.wklaw.com/practice-areas/eavesdropping-penal-code-section-632/>

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GDPR Chapter 5 · Transfers of Personal Data to Third Countries

GDPR Articles 44-50. Local-only AI inference avoids the third-country transfer analysis entirely.
<https://gdpr-info.eu/chapter-5/>

22

HHS HIPAA Security Rule Summary

HHS primary source for HIPAA Security Rule. Local processing keeps PHI on premises.
<https://www.hhs.gov/hipaa/for-professionals/security/laws-regulations/index.html>

23

NIST AI Risk Management Framework

NIST primary source for AI RMF MAP and MEASURE functions. Local model removes cloud risk class.
<https://www.nist.gov/artificial-intelligence/ai-risk-management-framework>

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C2PA Specification v2.4

C2PA primary source for content provenance manifests on AI-generated meeting summaries.
https://spec.c2pa.org/specifications/specifications/2.4/specs/C2PA_Specification.html