21M.380 · Music and Technology
Recording Techniques & Audio Production

Workshop: Cables, preamps, patchbays

Session 7 · Wednesday, September 28, 2016

1 Schedule

	Group A	Group B	Group C
	[redacted]	[redacted]	[redacted]
12:25pm	Equipment pickup ([redacted])		
12:35pm	Small moss road case overview (all groups)		
12:45pm	How to patch a microphone (all groups)		
12:50pm	Review QZ1	Patching exercise	Audio connections
1:05pm	Patching exercise	Audio connections	Review QZ1
1:20pm	Audio connections	Review QZ1	Patching exercise
1:35pm	Patching exercise results (all groups)		
1:45pm	Packing up equipment (all groups)		
1:55pm	End of class & return of equipment ([redacted])		

Table 1. Schedule

2 Small moss road case overview

2.1 How to open

- Identify front side first (labeled with white sticker) ☺
- 2 locks: left, right
  - Open with same key (but *other* key than the one for large case)
  - Please remember to return keys to me! ☺
- 4 latches (2 on each side): flip and twist

2.2 Standard studio gear dimensions

- Width: 19″ (sometimes 8.5″)
- Height: Multiples of 1U = 1.75″ ('rack unit'; sometimes called RU)

2.3 Left 19″ rack (from top to bottom)[1]

- Marantz PMD580 solid state recorder (stereo only recordings)
- Art ProAudio HeadAmp6 Pro headphone amp (ctrl. room monitoring)
- RME Fireface 800 audio interface (audio I/O for laptop)
- RME ADI-8 DS AD/DA converter (additional analog inputs to Fireface)
- True Systems Precision 8 8ch microphone preamp
- 2 Joemeek twinQ 2ch mic preamps (discontinued)
- 1 Vintech 1272 2ch mic preamp
- 1 JDK Audio R20 2ch mic preamp

2.4 Right 19″ rack (from top to bottom)

- Rack drawer (1U): laptop
- Hear Technologies Hear Back headphone monitoring hub
- RJ45 feed thru patch panel (Hear Back hub to Hear Back mixers)
- 2 Redco R196-D25PG Bantam patchbays (internal patching)
- 2 Switchcraft PT16MX2DB25 XLR patchbays (main I/O)
- Rack drawer (4U): Bantam patch cables etc.
- Tripp Lite LCR2400 2400 W power conditioner (main power switch)

2.5 Signal flow

- Chs. 1–8: Mic → XLR patchbay → Bantam patchbay → RME Fireface 800
- Chs. 9–16: Mic → XLR patchbay → Bantam patchbay → RME ADI-8 DS → RME Fireface 800

[1] The Moss schematics included in today's handout (Ariza 2012b) provide an overview of the small road case's layout, as well as its patchbay allocation and internal rack connections. This document will be useful not only today, but also in the future, so *please bring it along for all remaining workshops and recording sessions*.

3 Microphone patching

3.1 Things to keep in mind

- Rule of 👍: Patch from output (top row) to input (bottom row)
- Exception: secondary MOSS Bantam patchbay (also inputs in top row!)

☞ *Never patch under phantom power on a Bantam patchbay (temporary short circuit can destroy input stage)!*

3.2 Procedure

1. Remove mic from case and attach to stand
2. Connect XLR cable from mic to XLR patchbay
3. Patch mic to preamp input on Bantam patchbay *(48 V off?)*
4. Patch preamp output to audio interface (or ADC) on Bantam patchbay
5. Turn on preamp, engage phantom power (if needed), adjust gain
6. When you're done: clear levels, disengage phantom, turn off preamp
7. Unpatch *(48 V off?)*
8. Disconnect mic, return to case *with clip or cradle*, coil cable

4 Review QZ1

4.1 Instructions

- Review your corrected quiz for later discussion with the instructor.
- Identify at least one question (points that remain unclear).
- Discuss your question(s) with your peers as a group.

4.2 Discussion points for later

- Question 1.1:
  - *Complete* calculations (values deliberately chosen for easy arithmetic)
  - Make it clear what your actual *answer* is.
- Question 2.1: Make sure you interpret logarithmic scales correctly.
  - Scale starts at 10 Hz, not 0 Hz
  - 8 kHz ≠ 800 Hz
- Question 3.1: Red dot indicates front direction (positive phase) of fig-8, *not* polar pattern
- Question 3.4: Sennheiser MD421 is a *dynamic* mic (even though it looks similar to large-diaphragm condensers)

5 Patching exercise

5.1 General remarks

- No need to power up preamps for now (we'll do it together later)
- Use Moss patchbay schematics handout (Ariza 2012b, p. 1) for help
- Leave mic & cables in place when it's time to move on to next group

5.2 Task

1. Identify microphone and preamp and set up mic on a stand
2. Connect mic to correct channel on the XLR patchbay
3. Patch signal from XLR patchbay into correct preamp input
4. Patch preamp output into correct audio interface or ADC input

Student	Microphone →	XLR patch in →	Preamp channel →	Converter
[redacted]	AKG C414	1	Vintech ch. 1	RME Fireface input 1
[redacted]	AKG C414	2	Vintech ch. 2	RME Fireface input 2
[redacted]	AKG C414	3	JDK ch. 1	RME Fireface input 3
[redacted]	AKG C414	4	JDK ch. 2	RME Fireface input 4
[redacted]	Sennheiser MD421-II	5	Top twinQ ch. 1	RME Fireface input 5
[redacted]	Sennheiser MD421-II	6	Top twinQ ch. 2	RME Fireface input 6
[redacted]	Shure Beta 58A	7	Bottom twinQ ch. 1	RME Fireface input 7
[redacted]	Shure SM57	8	Bottom twinQ ch. 1	RME Fireface input 8
[redacted]	Audio-Technica AT4041	9	Precision 8 ch. 1	RME ADI-8 input 1
[redacted]	Audio-Technica AT4041	10	Precision 8 ch. 2	RME ADI-8 input 2
[redacted]	Earthworks TC20	11	Precision 8 ch. 3	RME ADI-8 input 3
[redacted]	Earthworks TC20	12	Precision 8 ch. 4	RME ADI-8 input 4
[redacted]	Audio-Technica AT4041	13	Precision 8 ch. 5	RME ADI-8 input 5
[redacted]	Audio-Technica AT4041	14	Precision 8 ch. 6	RME ADI-8 input 6
[redacted]	Audix D6	15	Precision 8 ch. 7	RME ADI-8 input 7
[redacted]	Sennheiser e604	16	Precision 8 ch. 8	RME ADI-8 input 8

Table 2. Patching exercise

6 Audio connections

Consumer equipment typically uses *unbalanced* lines

- Standard operating (line) level: $-10\,\mathrm{dB_V}$
- Limited to short cable runs (ca. 25′) due to interference
- High impedance

Professional equipment typically uses *balanced* lines

- Standard operating (line) level: $+4\,\mathrm{dB_u}$
- Longer cable runs possible
- Low impedance

6.1 Interference

- Electrostatic interference (prevented by cable shield)
- Electromagnetic interference (prevented by twisted pair, intelligent cable arrangement, balanced lines)

6.2 Balanced vs. unbalanced lines

- Balanced lines typically exploit the principle of *common mode rejection* to minimize interference
  - Requires extra wire with negative signal copy $-S$
  - Eliminate noise N (same on both wires) through differential amplifier
- Requires additional circuitry for signal inversion and subtraction, so balancing is a property of inputs & outputs, *not* of cables!

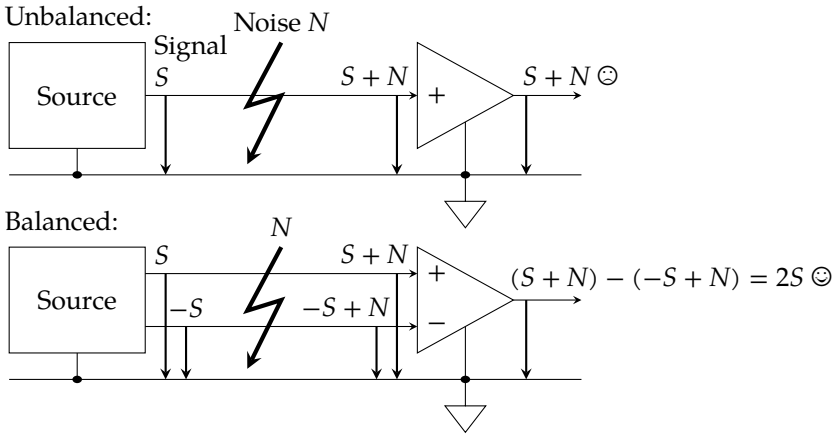


Figure 1. Principle of common mode rejection

6.3 DI boxes

- DI … direct injection; direct input
- Convert high-impedance unbalanced −10 dB_V signal to low-impedance balanced +4 dB_u signal
- Transformer isolation to remove hum from *ground loops*
- Active (48 V phantom power or battery) vs. passive; stereo vs. mono
- Available in MOSS: Radial JPC (active stereo) & Radial JDI (passive mono)
- Typical use: electric guitar, bass, keyboard (= unbalanced outs!)

6.4 XLR connector

- The 'microphone cable'
- One male end (XLRM), one female end (XLRF)
- So every XLR cable can also function as an extension ☺
- But also requires paying attention before uncoiling a long XLR cable
- Signal 'flows' from female to male (easy to remember: 3 pins 'point' in direction of signal flow)
- Press button on socket to free plug

6.5 TS & TRS connectors

- Tip (ring) sleeve
  - TS: 2 wires (unbalanced mono, e.g., guitar cable)
  - TRS: 3 wires (balanced mono or unbalanced stereo, e.g., headphones)
- Male on both ends (TR(S)M)
- Both TS and TRS come in different shapes:
  - A-gauge (angular tip)
  - B-gauge (slightly smaller rounded tip)
- A-gauge connector sizes:
  - 2.5 mm (rare, but available on some smartphones)
  - ⅛″ = 3.5 mm (laptop headphone output)
  - ¼″ = 6.35 mm (guitar cables)
- B-gauge connector sizes:
  - Bantam or TT: 0.173″ = 4.4 mm (e.g., MOSS Redco patchbays)
  - P0316 phone plug: ¼″ = 6.35 mm

☞ *Never plug 1/4″ A-gauge connector into 1/4″ B-gauge socket (bends contacts)!*

6.6 RCA connector

- *Never* balanced (only 2 wires)!
- Often comes in stereo (red/white connector pair on home hi-fi systems)
- Common adapter: ⅛"-TRS-to-RCA-stereo (laptop)

6.7 Snakes

- Multiple audio channels in a single cable
- Typically multiples of 8 channels (8, 16, 24)
- Channels are numbered and/or color coded
- Useful convention: follow resistor color code (cf., table 3)
- Larger snakes might have a *stagebox* connected on one end
- Larger XLR snakes are often bidirectional (sends & returns)
- Available in MOSS:
  - Hosa 8-channel TRSM-to-TRSM snake
  - Hosa 8-channel TRSM-to-XLRM snake
  - Pro Co StageMASTER XLR snake with stagebox (16 sends, 4 returns)

TABLE 3. Resistor color code for use with 8-channel audio snakes

Channel	Color
1	brown
2	red
3	orange
4	yellow
5	green
6	blue
7	violet
8	gray

6.8 Patchbay normalling

- Patchbays are often *normalled*, i.e., vertically aligned outputs and inputs are connected by default *within* the patchbay.
- Such a default (or: normal) connection does not require a patch cable in the front.
- Idea: maintain default routing setup that requires no patch cables (but can easily be overridden)
- Different normalling standards define which socket(s) one needs to insert a plug into in order to break the normal connection:

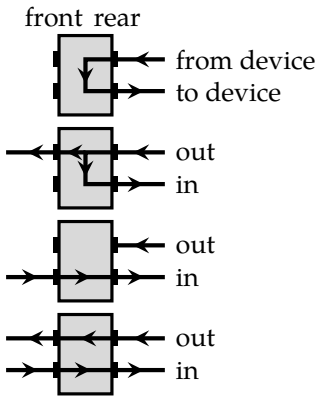


FIGURE 2. Half-normalled patchbay

Half-normalled patchbay: *Bottom* socket breaks normal connection

- Example: Top Redco patchbay in the MOSS
- Allows signal to be sent to two destinations simultaneously (passive split) ☺
- Use case: Direct outputs (monitoring, multitrack recording)

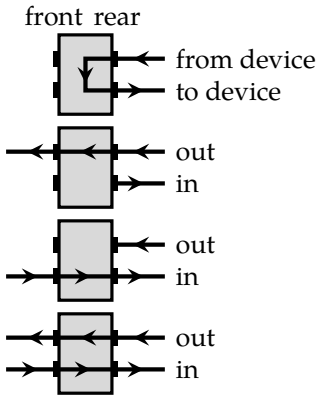


FIGURE 3. (Fully (or single)) normalled patchbay

(Fully (or single)) normalled patchbay: *Either* socket breaks normal

- Less common
- Use case: Connecting a source that should not have more than a single load (e.g., dynamic mic, high-impedance output)

Open (or denormalled) patchbay: No normal connection exists

- Top row (outputs) and bottom row (inputs) entirely independent
- But outputs are still above inputs
- Use case: Connecting normally unused effect

Parallel patchbay: Permanent normal connection (cannot be overridden)

- Both top and bottom socket represent *out*puts (passive split)
- Use case: Direct outputs (monitoring, multitrack recording)

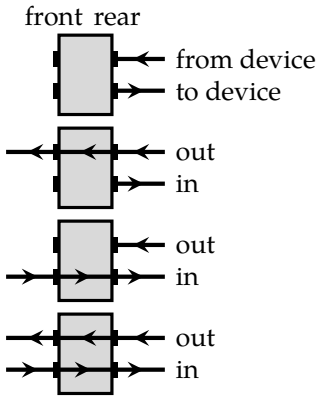


Figure 4. Open (or denormalled) patchbay

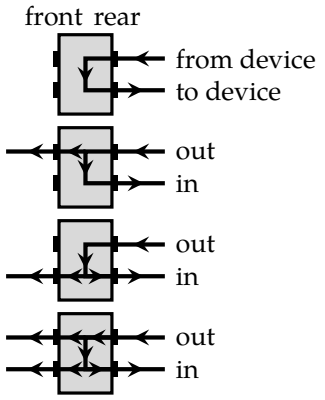


Figure 5. Parallel patchbay

7 Patching exercise results

- Let's power up the moss and its preamps
- Apply phantom power. Which mics require it (cf., table 2)?
- Let's randomly sample a few connections:
  - Visually monitor signal on preamp meter while setting levels
  - Visually monitor signal on audio interface or A/D converter

References & further reading

Ariza, Christopher (2012a). *Moss inventory*. Available at: MIT Learning Modules ▸ Materials.

— (2012b). *Moss schematics*. Available at: MIT Learning Modules ▸ Materials.

Davis, Gary and Ralph Jones (1989). *Sound Reinforcement Handbook*. 2nd ed. Yamaha and Hal/Leonard. URL: https://bgaudioclub.org/uploads/docs/Yamaha_Sound_Reinforcement_Handbook_2nd_Edition_Gary_Davis_Ralph_Jones.pdf (visited on 01/28/2017).

Macatee, Steve (2002). *Grounding and Shielding Audio Devices*. URL: http://www.rane.com/pdf/ranenotes/Grounding_&_Shielding_of_Audio_Devices.pdf (visited on 11/02/2013). RaneNote 151.

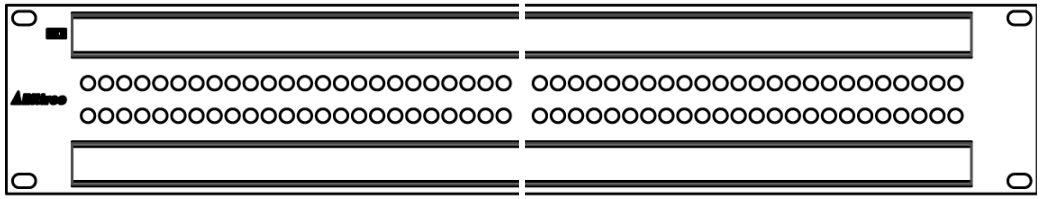
Rane Technical Staff (2015). *Sound System Interconnection*. URL: http://www.rane.com/pdf/ranenotes/Sound_System_Interconnection.pdf (visited on 01/26/2017). RaneNote 110.

Robjohns, Hugh (Dec. 1999). "Patchbays: Frequently Asked Questions." In: *Sound on Sound*. URL: http://www.soundonsound.com/sos/dec99/articles/patchbay.htm (visited on 11/02/2013).

MOSS schematics (p.1 of 2)

Primary patchbay (points 1-48): all half-normalled

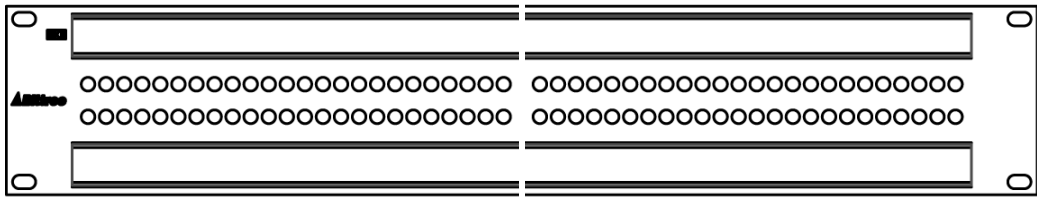
RME Fireface 800 1-8 OUT	RME ADI-8 DS 1-8 OUT (from 9-16 Fireface 800 OUT)	Switchcraft PT16FX2DB25 1-8 OUT	Switchcraft PT16FX2DB25 9-16 OUT	True Systems Precision 8 1-8 OUT	twinQ, twinQ, Vintech, JDK, 1-8 OUT



Switchcraft PT16MX2DB25 1-8 IN	Switchcraft PT16MX2DB25 9-16 IN	True Systems Precision 8 1-8 IN	twinQ, twinQ, Vintech, JDK 1-8 IN	RME Fireface 800 1-8 IN	RME ADI-8 DS 1-8 IN (to 9-16 Fireface 800 IN)

Secondary patchbay (points 49-56): all isolated

ART Hd.Amp 6 Pro 1-4 IN	580 1-2 IN 1-2 OUT



Hear Technologies Hear Back Hub 1-8 IN

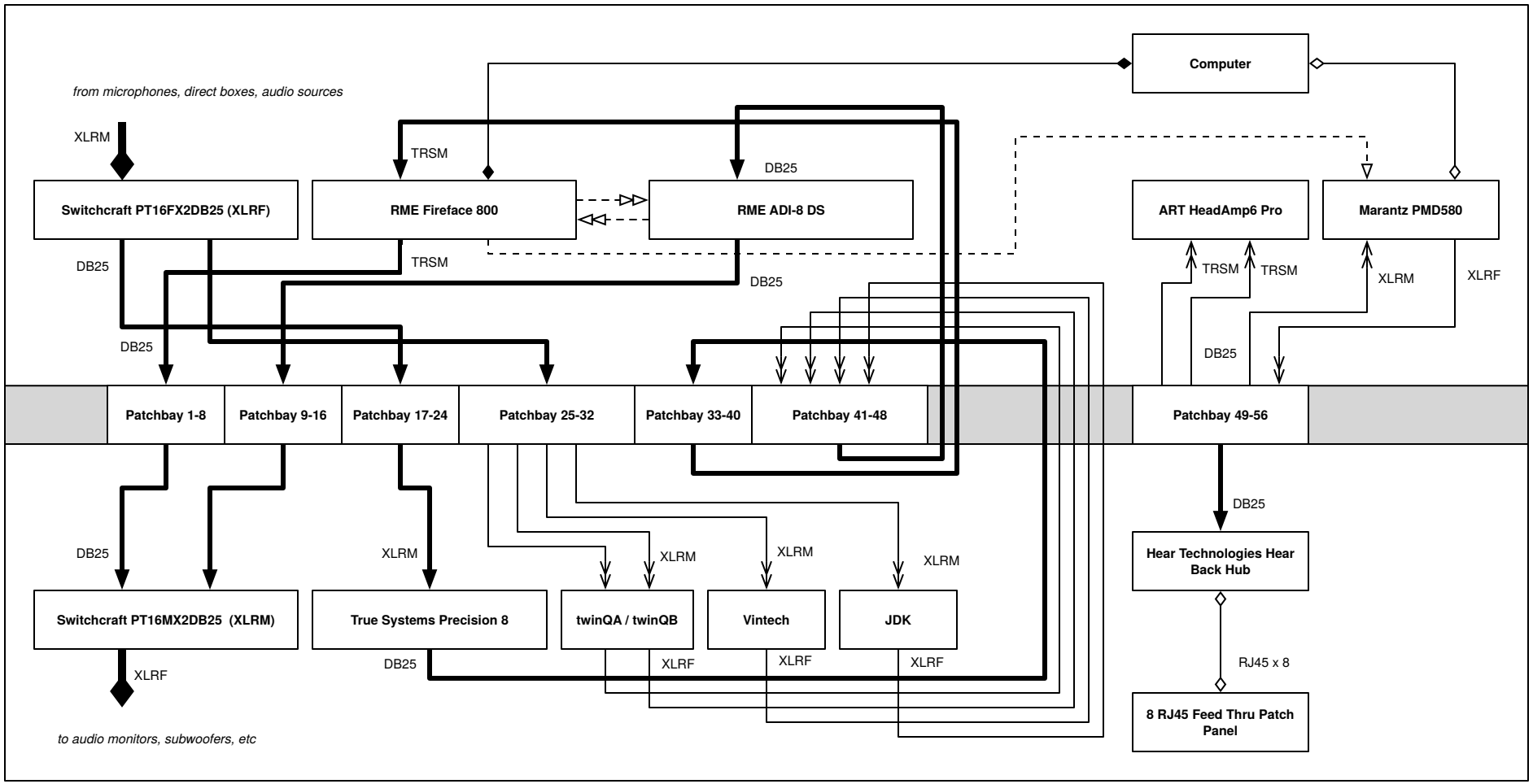
16-space double-wide rack (32 total spaces)

Marantz PMD580
ART ProAudio HeadAmp6 Pro
RME Fireface 800
RME ADI-8 DS
True Systems Precision 8
Joemeek twinQ
Joemeek twinQ
Vintech
JDK

Rack Drawer (Laptop)
Hear Technologies Hear Back Hub
8 RJ45 Feed Thru Patch Panel
Redco R196-D25PG
Redco R196-D25PG
Switchcraft PT16MX2DB25
Switchcraft PT16FX2DB25
4 Space Rack Drawer
Tripp Lite LCR2400 2400W Power

Internal Rack Connections

MOSS schematics (p.2 of 2)



16 Channel balanced analog (external)

8 Channel balanced analog

2 Channel balanced analog

1 Channel balanced analog

8 Channel double wire digital Toslink

2 Channel digital SPDIF

RJ45

Firewire

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