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Audio-Visual (AV) Technologies: 2024 Technology Planning Advisory

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1. Introduction

From the most intimate classroom environment to high-profile event spaces; from a simple PowerPoint shown in a meeting to a highly produced, interactive, live online event; Audio-Visual (AV) technologies play a key role in Harvard's teaching, learning, and research mission, and in all the activities that support it.

The shifts in collaboration and communications styles driven by the pandemic have sharpened the focus on the AV user experience and added AV technology to many more campus spaces. At the same time, the underlying technology architecture of AV systems is changing across the industry and is increasingly aligned and integrated with other technologies in the campus environment.

This report offers an analysis of the technology shifts underway in the AV industry and at Harvard, explores the complexity of adapting to these shifts in our organizationally fragmented landscape, and proposes recommendations to meet these challenges and prepare for present and future technology evolutions.

The report focuses on these core components of the AV landscape at Harvard:

- In-room display and audio (projection, screens, amplification, voicelift)
- Video and web conferencing hardware and software (Zoom, Teams, and similar)
- Recording for in-person and online meetings and events (automated systems, enabling hardware and software)
- Enabling infrastructure that supports these functions (network, integrated systems).

While not a focus of this report, the related technologies below are part of the broader landscape of, or interoperate with AV:

- Digital signage
- Media production services, systems, workflows, storage
- Media delivery (storage, streaming); and media preservation and retention
- Operational technologies (including cameras for security & operations support) (See related OT Horizon Report)
- Internet of Things (IoT) (See related IoT Horizon Report)
- Collaboration technologies (See related Collaboration Horizon Report)

2. Industry and Technology Trends

2.1. The Impact of a Changing Technology Landscape on Campus AV Integration

A changing technology landscape impacts the way AV is integrated into our campus infrastructure:

- From analog to digital and AVoIP: Twenty years ago, a typical classroom AV system would consist of a few source devices (microphone, computer, camera, DVD player), connected to a dedicated matrix switch to send content to its destinations (projector, speakers, monitors), mainly within the classroom. In systems installed today, although the sources and destinations may look very similar, content is being encoded and transmitted digitally using internet protocol (IP), then decoded for its destinations (AV over IP). While this technology can be used within the confines of a classroom, these systems are more often connected to the campus network, enabling remote monitoring and management as well as transmission of content.

- From standalone systems to integrated environments: AV systems can be, and are increasingly expected to be, integrated with other technology components in campus spaces, such as digital lighting and shade controls and building occupancy sensors.

2.2. Evolving Usage Patterns and Expectations in the Post-COVID AV Landscape

Accelerated and amplified by the shift to remote teaching, learning, and working during the COVID-19 pandemic, usage patterns and user expectations have evolved dramatically in the past 4 years:

- From **occasional/program-specific to ubiquitous use of web/videoconferencing** for meetings, classes, and events, and community expectations that any AV-enabled space will be able to support conferencing.
- From either **in-person *or* online meetings** to **hybrid**, with a mix of in-person and remote participants, so that AV is now a critical dependency.
- From **specialized support needs to plug-and-play user expectations**, as consumer technologies have incorporated functions that used to be reserved for dedicated AV systems, and as users are increasingly familiar with web conferencing tools. Individuals expect to find the same ease of use with AV technology on campus as they do with personal consumer devices.

2.3. Accessibility Implications for AV Technologies in Higher Education

A focus on making Harvard experiences accessible to all has implications for AV:

- AV technologies should aim to comply with the **University Digital Accessibility Policy** so that all members of the community have "the opportunity to acquire the same information, engage in the same interactions, and enjoy the same services."
- Consumer technologies leveraging personal devices for **assistive listening** have surpassed campus standards for in-room systems.
- Zoom and other conferencing technologies offer opportunities for **real-time transcription and captioning**; this can be of great benefit, but also increases reliance on and expectations for technology.
- Services for **captioning and American Sign Language (ASL) interpretation** have come to rely on Zoom to enable lower-cost remote providers, increasing dependence on technology to provide these critical services.

2.4. Emerging Technologies Shaping Future AV Investments in Higher Education

Technologies that have been largely experimental for use in teaching, learning, and research are becoming available in consumer-level devices, and expectations for more widespread use will drive AV investments, including:

- **Virtual and augmented reality** (VR and AR), also referred to as extended reality (XR)
- Other **3D visualization** of real (e.g. photographic) and simulated (e.g. models) data, sometimes requiring headsets and/or specialized facilities

3. Current and Potential Use Cases

3.1. AV Technologies Across Campus Mission and Activities

AV technologies (hardware and software) are installed and used across our campus and throughout the core mission and supporting activities.

- **Teaching and learning** leverages AV across all modalities, from fully in-person to fully online. Almost any class session across Harvard's schools will use a screen or projector to share content, but that's just the tip of the iceberg. Even a fully in-person course in Harvard College may bring in remote guest speakers for a few class meetings; several schools offer degree programs with significant online components. Diversity in offerings across schools, and even across programs within schools, means that the classroom portfolio needs to include spaces that enable these modalities.
- **Researchers** rely on conferencing technologies for day-to-day activities with hybrid teams, and for collaboration within and among institutions.
- Campus events, including **conferences** and high-profile guest **speakers**, have resumed on campus with high production and support requirements. Many events now also have an online component, ranging from live streaming to robust remote participation.
- Harvard's vibrant **performing arts** scene relies on performance venues with specialized sound, video, and lighting programs that go well beyond the needs of other campus spaces.
- **Harvard Athletics** strives to **r**ecord every practice and competition for coaching and broadcast.
- **Media teams** are striving to leverage networked AV investments for remote monitoring and management and looking ahead to the possibilities of remote production.
- **Everyday meetings** have become AV events as Harvard navigates the shift to a hybrid workforce. Some meetings require both facilitators and event producers to provide equitable inclusion of in-person and remote participants and operate increasingly sophisticated technology setups.
- **Libraries, Museums, and Archives** are responsible for collecting, curating, and preserving audio, video, and audio-visual data. Museum and cultural exhibits are made more accessible and enriched by immersive AV interactions.

3.2. Specialized Uses of AV Technologies

More specialized uses of AV technologies also support campus activities:

- Clinical skills instruction, medical simulation, and telehealth practices at Harvard Medical School
- Modeling and immersive visualization of archeological sites in FAS
- Gaming platforms used for immersive landscape design at GSD
- Modeling and visualization using REVIT in planning, design, and construction
- Augmented reality to place archeological finds in Harvard Yard
- 3D photography of campus spaces to create "Virtual Harvard"
- Drone video and photography of campus for Harvard University Planning and Design (HUPAD)

3.3. Harvard Spotlight on AV Investments and Usage

- Harvard spent an annual average of $16.5M on AV consulting and installation in FY21–23
- There are at least **1,700 AV-enabled spaces** (learning spaces, conference rooms, performance spaces) across the Harvard campus.
- There are approximately **120 staff** across Harvard in AV design/engineering/support roles.

- There were an average of **478,870** Harvard-hosted **Zoom or Teams meetings** per week in January 2024 (not including HBS).
- **7 professional studios** producing video recordings and hosting live online events

4. Key Trends and Drivers

4.1. A Diverse and Evolving AV Technology Landscape at Harvard

Harvard's AV landscape is diverse across schools (through a history of local decision-making and innovation to meet varying needs) and evolving both across and within schools (as new hardware and software platforms like QSC/Q-SYS gain traction, and as AV technology architecture moves to IP). Given the scope of the campus portfolio, this diversity and continuous evolution is an operating condition to be managed, not a problem to be solved. Coordination among schools in managing vendors; establishing technology architectural standards; and adopting shared approaches where appropriate, can enable more consistent user experiences and more strategic investment.

4.2. The Complexity of an Integrated AV/IT/Operational Technology Environment

An increasingly integrated AV/IT/Operational Technology environment brings more complexity; a need for better coordination among Harvard teams and integration among vendors; and a need for a wider, more diverse set of skills for technical staff. An AV technician needs more than a passing familiarity with IT networking principles to troubleshoot AV over IP devices; a network architect needs to understand the bandwidth demands of the AV program in a campus space to ensure that a building's network infrastructure can support it; a school security officer needs to understand how AV devices are being managed to ensure regular patching and maintenance.

4.3. Pandemic-Accelerated Shift in Community Expectations for AV

AV is not just a nice-to-have feature of campus spaces; it has become mission-critical and ubiquitous. The community expectation that AV will always be available when needed (especially in academic spaces) has outpaced AV and IT teams' ability to support it effectively, and challenges old patterns of downtime between semesters for maintenance and upgrades.

4.4. Evolving Campus Space and AV Technology Needs

An ongoing process of evolving how we use campus space considering changing teaching, learning, research, and workspace needs means that demands and expectations of AV technology will continue to evolve.

5. Vendor and Open-Source Offerings

Vendors in the AV technology space include hardware providers (control systems, audio and video input and output); software (control systems, conferencing, digital capture/storage/transmission); and services (consultants, integrator/installers, and event services). Diversity is a necessity here, to meet differing needs and priorities across schools and types of spaces, and predictably unpredictable demand for

services. We should aim for more strategic diversity across hardware, software, and service vendors to ensure availability of suitable service vendors when needed, and to mitigate the risk of over-reliance on a single platform or provider.

5.1. AV Hardware

The AV hardware vendor landscape comprises:

- Control systems: **Crestron** and **Extron** are the established vendors in this space, with a large installed base across campus. Some schools are beginning to adopt **Q-SYS** from QSC, which promises a more open, software-driven environment that comes closer to IT practices and patterns than the "black box" AV hardware of the past.
- Audio: **Biamp, Shure, Sennheiser, Dante** digital audio standards
- Projection and display: **Sony, Barco, Mersive** and Crestron **AirMedia** for wireless projection
- Conferencing: **Cisco**, **Logitech**, **Neat**
- Assistive Listening Systems (ALS): The industry is trending away from hardware solutions (inductive loop; RF) toward IP solutions (some rely on Wi-Fi and/or cellular connectivity, with implications for wireless connectivity coverage) that leverage individuals' personal devices or loaner devices.

5.2. AV Software

The software landscape includes:

- Room controls associated with the control systems hardware (**Crestron, Extron, Q-SYS**)
- Remote monitoring and management capabilities, including hardware-specific offerings from the vendors above, and 3rd-party tools that aspire to provide a unified dashboard across a heterogeneous environment
- Conferencing platforms: **Zoom** dominates this space at Harvard; **Teams** is also actively used especially in administrative settings. WebEx and Google Meet are very occasionally used by our community.
- Event capture, recording, and management: in addition to **Zoom recordings**, **Panopto**'s lecture capture solution is widely used across Harvard's schools.

5.3. AV Services Vendors at a Glance

AV service providers include design consultants, integrators/installers, and event services. Harvard currently has Master Services Agreements (MSAs) with four integrators: **AVI-SPL** (large national firm that acquired AdTech); **CCS** Presentation Systems; **McCann** Systems; and **OneDiversified** (acquired HB Communications). Other integrators working on campus include: **CAVT** Solutions; RenVisioning IT (**Rev-T**); **Pro AV**; and **DGI** Communications. AV consultants (and other consultants engaged for AV projects) include: **Cavanaugh Tocci** Associates (CTA); Communications Design Associates (**CDA**); **Acentech**; **Arup**; and **WaveGuide** (part of Compass Group - USA). Event and support service providers include: **High Output**; **Terry Hanley** Audio; **AVFX.**

6. Impact / Change Management

How must Harvard adapt to ensure that AV technology can continue to serve the academic mission and the administrative management of the institution, even as the technology itself is evolving and changing? We must first recognize that the recent and continued raising of community expectations and growth of

the installed footprint of AV technology requires rethinking how we plan, staff, partner and budget for the operations and renewal and replacement of these technology investments. What might this look like?

6.1. Academic planning leaders (academic programs, registrars, etc.)

Advocate for the programmatic and pedagogical needs of the teaching and learning mission, and for learning space designs aligned to those needs, so that investments in the digital and physical infrastructure are supporting the mission.

6.2. Campus planning and operations leaders

Work collaboratively with IT and AV functions to plan and manage holistically for the integrated technologies in campus buildings, especially in capital construction projects, so that the community can understand and effectively use both the physical and digital infrastructure.

6.3. Finance leaders

Ensure that capital investments in AV infrastructure, technologies and services are aligned with appropriate levels of operational and renewal and replacement budgets, so that the technology is supported, managed, and refreshed, and readily available to the community in support of teaching, learning, and research.

6.4. IT and AV leaders

Establish robust, forward-looking technology strategies and standards, so that the digital campus infrastructure can continue to evolve as new technologies emerge and community needs change.

6.5. Human Resources leaders

Invest in the development of an organizational capability that reflects cross-disciplinary skill sets across AV, IT, Operational Technology, and Security disciplines, so that teams are well-equipped to plan, manage, and support the integrated technologies that comprise the digital and physical campus infrastructure.

7. Risks, Challenges, and Considerations

The deeper integration of AV technologies into the day-to-day operations of the University and into the campus network and integrated technologies present risks to business continuity, technical operations, and information security.

7.1. Capital investment risk

- Harvard does not have consistent practices or policies to ensure the renewal and replacements of critical AV assets as they reach obsolescence and fall out of support, increasing the risks noted above. AV assets are managed locally, and to varying degrees, within schools and units. How can we work toward more robust practices and policies to mitigate the risks presented by obsolete technology?

7.2. Business continuity

- The COVID pandemic forced us to face the business continuity scenario of how to continue the Harvard mission when the community had to depart campus—and the response was to leverage web conferencing and related AV technologies to continue the mission remotely. As we've returned (partially) to campus, now we must ask: how do we continue the Harvard

mission, if the AV technology in a single classroom, single building, or across campus is completely unavailable? With teaching, learning, and research activities critically reliant on AV technologies, and community expectations for zero downtime of AV systems and services, we must ensure that the level of investment and support reflects the mission-critical functions these technologies support. Community tolerance for downtime for updates and renovations has decreased, further constraining schedules for important maintenance and improvements. How do we meet these expectations?

7.3. Vendor reliance

- There are advantages to standardizing on specific vendors for AV hardware, software, and services — consistent user experiences; ease of support; volume discount equipment pricing; institutional knowledge through ongoing relationships. But the technology and vendor landscape will always be evolving: the mature partner five years ago may not be current today, risking technology and skill-set obsolescence; the reliable hardware vendor today may not keep up with the next evolution of networked AV standards; the integrator who does a great job on classroom projects may not have the skill set to design and implement a high-profile event space. How do we strategically diversify our investments and relationships with AV hardware, software, and service vendors at both School and University levels and achieve a beneficial level of managed competition?

7.4. Network risk

- AV devices that used to communicate only to one another are increasingly integrated into campus networks, and a misconfiguration or vulnerability that would have impacted only a single system in the past could now impact network performance across campus. What safeguards can we put in place to mitigate this risk without compromising the opportunities that networked AV provides?

7.5. Security and privacy risk

- As AV continues to be integrated into on-campus, remote, and hybrid environments, a higher degree of monitoring is required to ensure we conform to security and privacy standards and practices.

8. Recommendations

AV and integrated systems are mission-critical campus infrastructure, and require ongoing, strategic technology and organizational planning and investments to meet the evolving needs of the community. Broadly, Harvard leaders should work together to **optimize investments** through shared practices and common services; strive toward providing **consistent user experiences** across schools and campus spaces; and **prepare for future needs** by fostering ongoing exploration of emerging technologies.

8.1. Optimize investments:

- Improve **organizational and process integration** among IT/AV and Facilities/Capital Planning/Capital Project processes, alongside other critical campus IT infrastructure including network, operational technologies, and communications technologies. Establish policies and practices to ensure that AV devices and infrastructure are inventoried, renewed, and refreshed to mitigate the risks of obsolescent technology.
- **Track spending** on AV installations and operations to help mature capital and operational budgeting processes for AV investments and services.

- Create, promulgate, and maintain an evolving set of **AV standards** in both functional and Construction Standards Institute (CSI) format to establish a common foundation for all campus AV investment, and upon which schools and units can build to meet local needs.
- Seek opportunities to **invest in and leverage common platforms and services** in support of an evolving and heterogenous AV environment across schools and units.
- Balance in-house services and diversified, **strategic vendor relationships** to provide robust operational support and be able to scale to meet evolving campus needs.

8.2. Improve user experience:

- Establish **university-wide guiding principles** for AV and integrated systems to prioritize user experience, interoperability, security, and accessibility.
- **Ensure operational support** for increased technology investments through sound financial planning and funding for regular reinvestment and technology refresh.

8.3. Prepare for the future:

- Engage in technology **strategic planning with integrated and adjacent technologies** (network, operational technologies, communications, collaboration) to better manage converging needs for the digital Harvard campus.
- **Partner strategically with vendors** (hardware, software, consultants, integrators) to advance campus technology standards while ensuring ongoing support for existing investments, recognizing that the lifecycle of AV investments can be longer than the lifecycle of a standard.
- **Investigate and integrate emerging AV technologies** that offer innovative ways to enhance teaching, learning, and research experiences, such as extended reality (XR) and 3D visualization.

9. Conclusion

AV technologies are mission-critical and increasingly integrated with other components of the digital campus environment. Harvard should apply the IT principle of treating common components and services as commodities—seeking opportunities for shared platforms and investments—so that schools and units can focus on innovating to meet the unique local needs of their communities and can explore and incubate new technologies.

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