Improving BME Support by Remotely Locating Third Party Systems in Catheterization and Electrophysiology Labs

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***Abstract*— The University of Ottawa Heart Institute Biomedical Engineering team has found many benefits to relocating third-party medical devices and equipment from the control and procedure rooms of both catheterization and electrophysiology labs and moving them to a remote equipment room. This paper covers how the team achieved success in setting up a fully functional equipment room and what considerations to take when deciding to implement this type of workflow.**

***Keywords*— Medical Devices, Catheterization Lab, Electrophysiology Lab, Equipment Rack, Audio and Video Equipment**

I. Introduction

The University of Ottawa Heart Institute (UOHI) constructed a new life support tower in 2018 that houses our state-of-the-art Catheterization (Cath) and Electrophysiology (EP) labs. These labs are divided into three rooms: a procedure room, a control room, and an equipment room. Devices and computers that can be separated from their user interfaces are installed in the equipment room. Examples of this include 3D cardiac mapping computers, where the computer is placed in the equipment room on an equipment rack and the video and USB signals are extended to the procedure and/or the control room. Another example is our cardiac monitoring devices where the "base station" is installed in the equipment rack and the measurement module is mounted on the table in the procedure room. The benefits of using an equipment room are to have a temperature-controlled environment free from any dust or accidental bumps and spills, to reduce unauthorized access to critical equipment and to free up space in both the control and procedure room[1]. See figure 1 for an overview of the layout and signal flow within a standard UOHI Cath lab.

II. Materials and Methods

There are many ways to remotely locate the equipment outside of the control and procedure rooms. Many vendors now offer AV integration systems such as Olympus, Karl Storz and Philips. In 2017, The UOHI Biomedical Engineering (BME) team reviewed available options and determined the best option would be to have a standard set of AV equipment consisting of video and USB extenders, video splitters and video converter/scalers for each system and use signal cables (Cat 5, VGA, DVI, etc.) to transmit the signal to the desired location. Benefits of using simple standardized components are: They are easy to support and troubleshoot, are economical and reduce the amount of spare equipment needed to purchase and store[2].

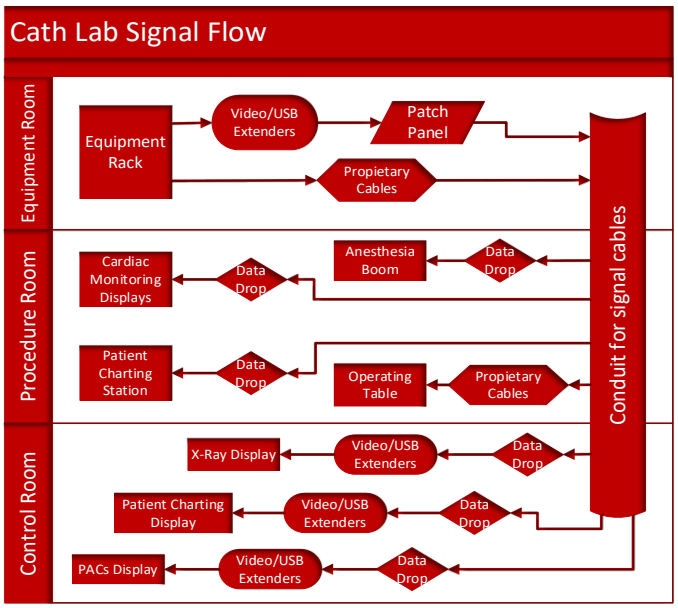

Fig. 1 Cath Lab Layout and Signal Flow

An equipment rack was purchased to house the medical devices/computers, AV equipment and patch panel. See figure 2 for an example of a typical Cath Lab equipment rack setup. The signal cables that were used were dependent on the type of signal being processed and the device requirements. Whenever possible, patch cables or dongles/jumpers were used to connect the medical device computers to the AV equipment, then to the rack mounted

patch panel and finally going to a wall mounted patch panel. From the wall mounted patch panel, patch cables were then pulled through conduit running in the ceiling and/or floor to their end destinations in equipment booms, anesthesia gas columns and data drops within the millwork of the procedure and control rooms. Segmenting the signal cables this way is useful for troubleshooting, especially if a cable needs to be replaced, BME can just replace that specific segment instead of needing to pull new cables through the conduit. The cables that do run through the conduit are protected from any movement and normal wear and tear making it very unlikely that they would need replacing. This also eliminates the need for the BME work in high traffic areas of the control and procedure rooms such as under desks and in turn reduces disruptions to clinical operations.

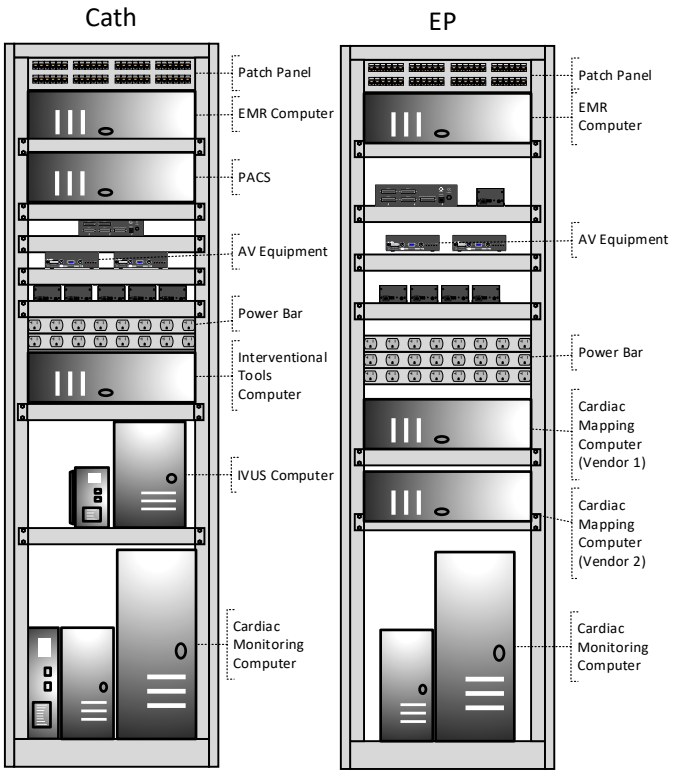

Fig. 2 Cath and EP Equipment Racks

III. Diagnostic Imaging Integration

In addition to housing our third-party systems, our equipment room houses the fluoroscopy system cabinets and system UPS. The fluoroscopy system has a built in AV system, which transmits video feeds to an in-room surgical display and three displays in the control room (X-ray live, X-ray review and other). By having the third-party systems located near the fluoroscopy system cabinets, their video signals can easily be split and integrated into the fluoroscopy systems video feeds. This workflow offers the clinical users a convenient way to access all video signals in a central location while keeping the procedure room and control room clean and free from any cabling, tripping hazards and heat buildup.

IV. Discussion

Since the equipment rack houses different types of medical equipment of varying brands and ages, BME had to consider the best way to effectively transmit each signal for the given technology. The types of cables we have terminated in the patch panel are RJ45 (Cat5), fiber optic and coaxial. For output sources other than those mentioned, such as DVI or VGA, our AV equipment comes into play which consists of a variety of standard third-party signal processing devices such as DVI to RJ45 video extenders, USB to RJ45 extenders, VGA to DVI video scalers, DVI to fiber optic adapters and more. For any proprietary cables or if the signal quality could not be maintained with AV equipment, cables were pulled directly from the equipment room to the end destination. One example of this is the propriety cable that connects the cardiac monitoring computer to the measurement module sitting on the operating table. This cable was propriety and had a fixed length, so it had to be run through the base of the operating table through the conduit in the floor and back to the equipment room.

Additional points to consider when choosing AV signal processing devices are the run length of your cables, signal degradation (If the signal needs boosters/attenuators) and power requirements (whether these devices use inline power, USB power delivery or external power adapters).

V. Conclusion

While there are many considerations to take when designing and implementing a location to remotely store third party devices within the Cath and EP labs, the UOHI BME team has found there to be significant benefits such as preventing downtime due to accidents by clinical staff, a reduction in preventative maintenance by having the devices in a temperature controlled and dust free environment and more efficient troubleshooting.

Acknowledgement

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Conflict of Interest

The authors declare that they have no conflict of interest.

References

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Abbreviations

- UOHI – The University of Ottawa Heart Institute
- BME – Biomedical Engineering
- AV – Audio/Video
- Cath – Catheterization
- EP – Electrophysiology
- UPS – Uninterruptible Power Supply