VIDEO INTEGRATION WITHIN AN ELECTROPHYSIOLOGY LABORATORY: A COST EFFECTIVE APPROACH

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INTRODUCTION

The Electrophysiology (EP) Laboratory is one of the most complex procedure rooms operating in a cardiovascular institution. The practice of cardiac electrophysiology includes the investigation, diagnosis, and treatment of electrical abnormalities of the heart. Detection and analysis of irregular electrical pathways require specialized medical technology including but not limited to fluoroscopy, cardiac mapping systems, electrical stimulators, physiological and electrophysiology monitoring, and echocardiography. Treatment options include radio-frequency ablation, cryoablation, and medical device implants including internal pacemakers and internal cardiac defibrillators (ICD). In addition some EP Laboratories utilize robotic catheter navigation systems to facilitate diagnosis and treatment. In order for the electrophysiologist to perform these complex cases with efficiency and efficacy, information from these various technologies must be quickly available wherever required. The University of Ottawa Heart Institute (UOHI), Ottawa, Canada constructed a second EP Laboratory in January 2009. The research, education, and new treatment protocols, to be performed in this laboratory required a functional, flexible, expandable, and cost-effective solution for video integration.

METHODS

As with any formal project management approach, several steps are required in order to ensure a successful implementation. These include identifying mission and objectives, defining the scope of work and needs analysis, determining clinical to technical needs, planning, procurement, and implementation. For this particular project, the Department of Biomedical Engineering (BME) at the UOHI worked closely with the physicians, nurses, technology staff, architects, and planners to plan, design, construct, and install a low cost integration solution that allowed EP staff to direct and control medical information displays.

NEEDS ANALYSIS

A Needs Analysis was performed through discussions with all stakeholders including nurses, technologists, and physicians, to identify all sources of information required to carry out the procedures. This included a complete audit of all possible video sources of information that are utilized within the EP procedure and control rooms. This audit included those systems that are in constant use regardless of procedure and also portable systems that on occasion may be used within the procedure room. Interviews with clinical staff identified the display presentation requirements of the varieties of information and also the physical location of this technology within the procedure room. As an example, the anesthesia physiological monitoring information recorded at the patient head area was required to be seen by the anesthesiologist, EP physician or fellow within the procedure room, and also the EP technologist within the control room. The audit resulted with a matrix of video signal sources, types, and locations.

CLINICAL TO TECHNICAL NEEDS

A review of the technical capabilities of the required medical technologies was performed. In addition, it was revealed that all video sources were required to converge at a single location within the EP Laboratory in order for video switching to occur for multiple displays. As a result, a single equipment rack location, within the control room was identified as a central location for all video switching components, medical technology hardware, and KVM components. Centralization of all computer hardware associated with the various systems into one area cleared valuable real estate within the procedure room and control room allowing for a cleaner, efficient, and adaptable space. Schematics of electrical, infrastructure, and cabling requirements were created based on the technical requirements. Figure 1 is a general schematic of the conduit requirements created and presented to the architects responsible for the detailed drawings of this project. Reviewing the video requirements determined the video technology required to appropriately switch, scale, control, and transmit the video signals to various displays. Custom connection boxes were strategically placed at various locations with the procedure room as auxiliary video input connectors. These locations included the anesthesia boom, and at the base of the foot of the fluoroscopy table.

PROCUREMENT

Through past experience in similar projects and discussions with vendors, sourcing of video integration components was performed to identify components, devices, and final configurations of the system. As opposed to purchasing "turnkey" solutions from manufacturers, which often are cost prohibitive, the same integration devices and electronics can be purchased directly from distributors, installed, and programmed achieving the same result and performance at a vastly reduced cost. Vendor provided solutions were quoted at over

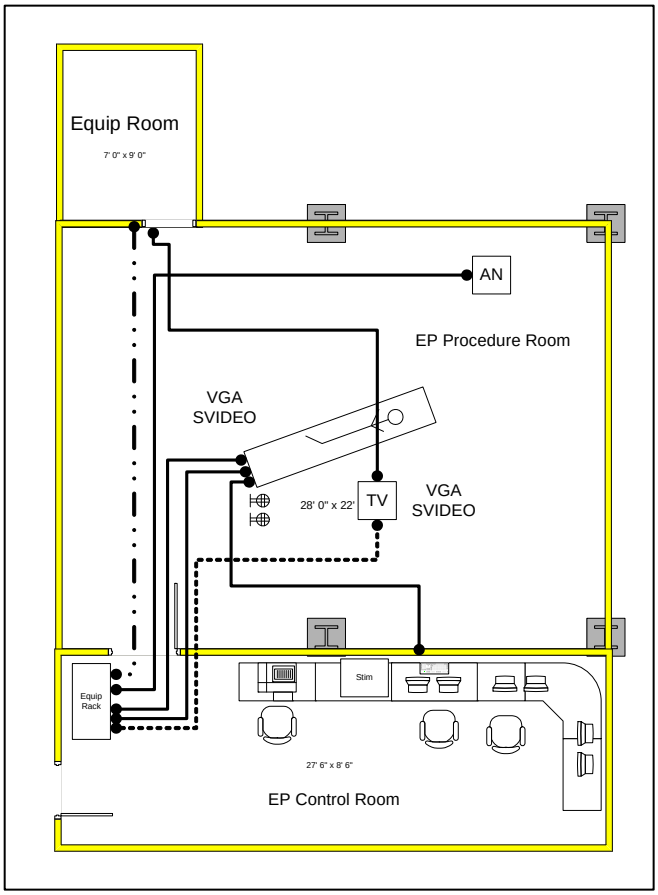

Figure 1. General schematic of EP laboratory layout and conduit requirements.

$100,000, whereas the total cost of the components acquired for this project was less than $15,000. In addition, all computer and display hardware were sourced from preferred vendors with the UOHI at a discounted cost achieving additional savings.

IMPLEMENTATION

Installation and commissioning of the technology required approximately 200 hours of BME staff time. This work required careful scheduling with clinical staff, vendors, and general contractors to ensure all timelines and milestones for the project could be met. There are a total of fourteen (14) video and computer monitors with several computer workstations. Six (6) of the video monitors are located in the procedure room on a monitor boom above the fluoroscopy table

with the remainder in the control room. Five (5) of the displays are capable of displaying any video signal while the remaining displays consistently show the same information as required by all types of EP cases. The control room has three (3) available monitors and the fluoroscopy monitor boom has two (2) controllable displays. From within the control room, any video source including auxiliary equipment such as echocardiography, intracardiac echocardiography (ICE), pacemaker programmers, and anesthesia physiological monitoring can be displayed wherever the staff needs it. Switching is controlled via a very simple interface in the equipment rack from where the EP technologist can select and direct video information as required.

DISCUSSION

Under financial constraints, the UOHI required the construction of a second EP laboratory to meet the growing demands of patients with arrhythmia problems. BME recognized that although funding was limited, this did not preclude the designing and implementation of a sophisticated video integration system to better service EP physicians and clinical staff. Through thorough needs analysis, translation of clinical to technical requirements, creativity, and planning, a cost-effective solution was implemented to meet the needs of our patients. Flexibility and control is built in the system to facilitate the switching of key video signals to allocated monitors. Utilizing inexpensive "off-the-shelf" components and technology, this method of integration can easily be extended to the cardiac catheterization laboratory, cardiac operating room, hybrid procedure rooms, and other care areas.

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