EXPERIENCE WITH GROUP-VIEW, WALL PANEL DISPLAYS OUTSIDE THE NUCLEAR INDUSTRY

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ABSTRACT

The first of the Generation III+ Advanced Light Water Reactors with advanced digital control rooms are nearing completion or, in some cases, already operational. Compared to their predecessors these control rooms represent a major step change in the display of information. Large panel multiple screen "wall" displays using Keyboard Video Mouse (KVM) networks are the centerpieces of the control rooms of Generation III+ (Gen III+) Nuclear Power Plants. For example, the AP1000 control room wall display consists of 12 wide panel screens. Stations for operators in the control room have four screens. While a very dramatic change for the nuclear industry, other industries have many years of experience operating with these types of displays in operations centers and so called "war rooms". This paper will outline some of that experience.

First experience is reviewed from the oil and gas industry drilling operations, which faces a multitude of complex business challenges. Asset Integrity Management (AIM) using a control center is an overarching approach designed to address these challenges. Experience from the defense industry is then examined. In most cases, a military command and control center's wall display and KVM routing systems are considered mission critical. They usually provide highly sensitive or very important content to users who are driving key operations and making mission critical decisions. Also examined air traffic control systems and associated training facilities. Finally the experience of a major independent regional electric transmission and distribution organization in building a new 70,000-square-foot Backup Control Center (BCC), some 24 miles from the main control system is described.

Key Words: KVM, Wall Displays, Control Room

1 INTRODUCTION

The first of the Generation III+ Advanced Light Water Reactors with advanced digital control rooms are nearing completion or, in some cases, already operational. Compared to their predecessors these control rooms represent a major step change in the display of information. Large panel multiple screen "wall" displays using KVM networks are the centerpieces of the control rooms of Generation III+ Nuclear Power Plants. For example, the AP1000 control room wall display consists of 12 wide panel screens. Stations for operators in the MCR have four screens. While a very dramatic change for the nuclear industry, other industries have many years of experience operating with these types of displays in operations centers and so called "war rooms". This paper will outline some of that experience.

One of the first observations for the design of advanced reactor control rooms is that individual video display units (VDUs), let alone individual mouse and keyboard interaction would be an overwhelming interface for an operator. A key enabling technology for improving the Human System Interface (HSI) for the Gen III+ has been the use of Keyboard-Video-Mouse (KVM) switching and extension. Thinklogical is the supplier of the KVM network for AP1000 as well for many non-nuclear industries. There experience in supplying these systems is the focus for this paper.

1 OIL AND GAS DRILLING REAL-TIME OPERATION CENTERS

The oil and gas industry drilling operations faces a multitude of complex business challenges. Asset Integrity Management (AIM) is an overarching approach designed to address these challenges by getting people, processes and technology working together to improve productivity, safety and security, while also protecting the environment. Critical to these AIM objectives is the Real-Time Operations Center (ROC) and its underlying systems. The ROC is a centralized, cross-functional collaboration center with access to the video-rich data necessary to make timely and high quality decisions.

In support of AIM, the nature of what was previously known as a "control room" has changed dramatically. In today's digital oilfield, the traditional control room has evolved to a multi-faceted facility more commonly known as a "Real-Time Operating Center" or ROC. A ROC is an exponentially more data rich environment, evolving to include high-resolution video and audio surveillance. It is more collaborative in two significant ways: 1) different disciplines and functions are working within the same room, and; 2) field and headquarters personnel are working together through virtual video tele-presence technology. The ROC is also more flexible, through its ability to be reconfigured through rapid and dynamic access to the critical systems, information and personnel required to address any number of situations or decisions that need to be made. Finally, the ROC is, in most cases, able to function in near real-time.

A critical underlying component of the ROC is the secure control, management and distribution of real-time, video-rich information to facilitate this cross-functional, collaborative and therefore higher quality decision-making. The system chosen for this task is of utmost importance to achieving the ROC's objectives. Instability in the system can lead to ROC downtime during critical periods. Less than adequate performance can lead to image latency, pixelation, artifacts or lost frames, impairing the ability to make high quality decisions. Insufficient security measures can result in the leaking or breach of mission critical data, hacking, cyber-attacks or even the crippling of operations. For these reasons, it is important to understand the key design considerations and best practices for the ROC's underlying data system and how that system needs to support the objectives of AIM.

2 MILITARY COMMAND AND CONTROL CENTERS

Further insight in to using KVM Networks and large wall display systems in nuclear plant control room can be gleaned from defense industry experience with secure high reliability command and control center displays. The proliferation of intelligence, surveillance and reconnaissance (ISR) information is radically changing the landscape of national defense. Asymmetrical threats, multi-domain battle locations, and dynamic mission requirements make information acquisition and analysis a key weapon for the modern defense team. In most cases, a command and control center's wall display and KVM routing systems are considered mission critical. They usually provide highly

sensitive or very important content to users who are driving key operations and making mission critical decisions. For these reasons, the security characteristics of Display and KVM routing systems are of paramount concern:

- Access to any networks, at all levels of classification
- Access to any collaboration (desks, video walls, conference rooms)
- Lower the classification level of a room in minutes, not hours
- Uncluttered, less noise, more productive and efficient work environment
- Higher availability, longer life of computers and lower total cost of ownership
- Less equipment as a result of pooling resources
- Adaptable and future ready system
- Full redundancy and resiliency
- Computers, USB port, and network ports are not accessible by the user
- Air gapping requirement moved to the rack room
- Matrix switch approved and certified to information assurance accreditations such as NATO,
- NIAPC, Common Criteria EAL4, US DOD DISA JTIC UCR and Tempest

Five key design criteria are recommended by a leading supplier of display systems:

1. The system architecture should physically secure and separate the target of the attack (content or system operation) from the threat: people.
2. The technologies used in the system should eliminate the ability to attack from a distance; that is, sniff or eavesdrop on the system.
3. The system should allow the administrator to closely manage and control access in accordance with the organization's security policies.
4. The system should automatically and continuously monitor for and identify breaches.
5. The system should be resilient; that is, it should be designed to not only withstand an attack, but also recover quickly following one.

The U.S. Navy's Broad Area Maritime Surveillance Unmanned Aircraft System (BAMSUAS) is designed to support a variety of all-weather maritime ISR missions. The BAMS program uses a high-end KVM and display system to provide an infrastructure for a maritime ISR data collection and dissemination capability that provides continuous situational awareness.. The display system is accredited for Information Assurance by the (NSA) Common Criteria, EAL 4, and for use in NATO multi-classification environments and therefore able to be deployed throughout the BAMS program. It provides a homogeneous infrastructure with sufficient bandwidth to handle any uncompressed video, peripheral or secure computing challenge. The KVM Based Wall panel system provided the BAMS Mission Control System operators with a user experience that is not compromised, even when accessing multiple systems


*Provisions will be made for 3rd
Instructor Operator Station.
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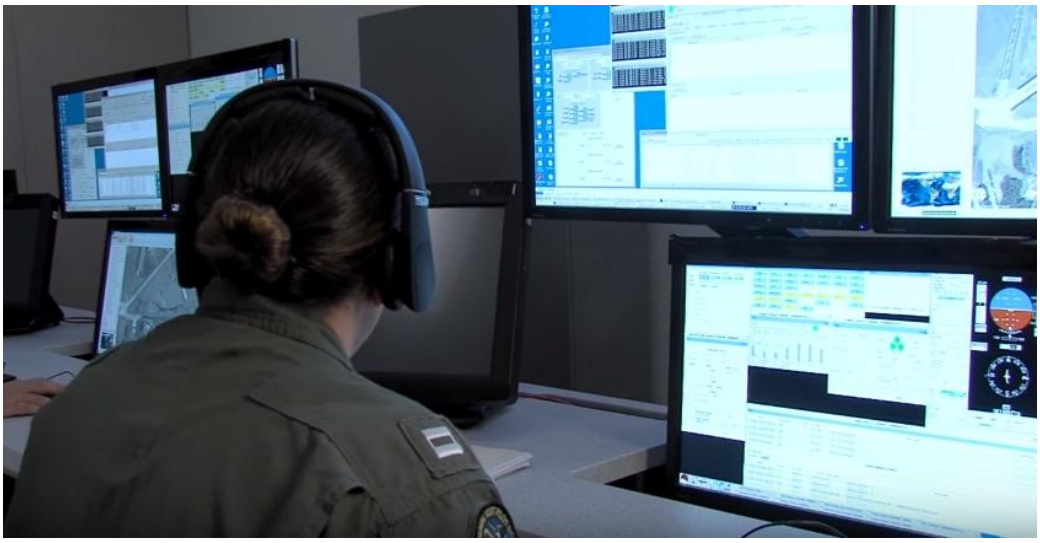
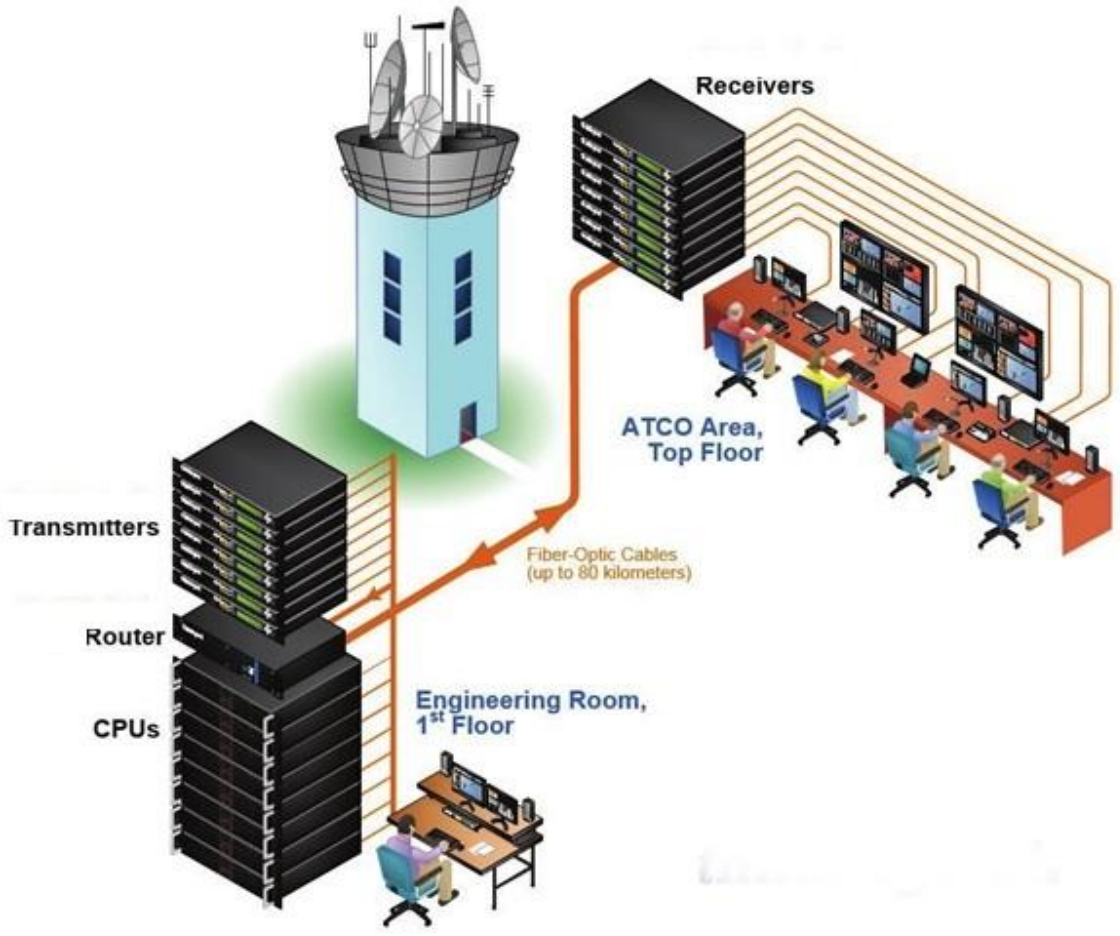


3 AI R TRAFFIC CONTROL

According to the FAA, in 2017, global air traffic passenger demand increased by 8.1 percent on the year before. In 2018, traffic is projected to grow with another seven percent. The continued growth in air traffic combined with heightened security concerns and new regulations focused on improving the quality of air traffic control (ATC) requires an environment that, like a nuclear plant control room, is secure, provides immediate access to resources and delivers a work environment that ensures the highest level of concentration can be maintained during operations.

The use of high-performance KVM extension and routing solutions to provide Clear readily understandable displays of information plays a key role in the modernizing ATC systems worldwide. These systems must be responsive to the heightened security requirements and regulations these organizations face. Such systems and solutions help to limit ATC operational risks, improve workflows, abide by regulatory compliances, and provide state-of-the-art visualization solutions. With increase training demands, large wall display that can simulate up to a 360 degree field of vision have been developed. High-end KVM extension and display systems provide a secure, efficient and reliable solution to meet demands of the ATC industry.

A typical high-end KVM system's Air Traffic Management solution combines a family of KVM transmitters and receivers, optical matrix router technology and a centralized system that provides maximum flexibility for establishing an environment that meets the specific requirements of air traffic controller facilities or airport control tower operations.



A broad range of KVM transmitters and receivers are available that provide the physical connections needed for air traffic controllers to access remote resources and to customize their workstation environment. Air Traffic Controller workstations can be configured with dual interface DVI terminals and support up to four high resolution monitors at a single workstation. The keyboard, mouse and microphones are connected through standard interfaces allowing both voice and data communications. Additional peripheral devices can be connected via USB interfaces.

Characteristics of the ATC KVM Display Network include:

- High availability and secure systems that ensure immediate real-time access to mission critical computing resources located anywhere across facilities and operations
- Transmission of uncompressed video images (pixel for pixel, no dropped frames) which are seamlessly transported to the end user, providing them with detailed and immediate visibility to critical images and data
- Improved workflow dynamics from leveraging content and equipment access, multiple computers can be accessed from one console
- Hot-swappable product components- in the unlikely event of a component failure and hot-swappable components (power supplies, fans, I/O cards) which provide for maximum uptime (24/7) and high availability
- Extension of computing resources up to 80 kilometers, which allows control rooms to be located away from the engineering or computer room
- SFP+ modules are MSA compliant - SFP+ are hot swappable and have a higher MTBF of 5.9 million hours
- Integration with external CWDM and DWDM platforms -provides further aggregation of ber network
- Extremely low MTBF across all systems and components
- Dry contact alarms and remote control and monitoring system - provides a centralized awareness of the equipment performance and availability

4 ELECTRIC TRANSMISSION AND DISTRIBUTION BACK UP CONTROL CENTER

A major independent regional electric transmission organization. that decided to build a new $39 million, 70,000-square-foot Backup Control Center (BCC), some 24 miles from the main campus. In an innovation unique to the industry, the new BCC is designed as a dual-purpose facility, acting as a Backup Control Center and a training and simulation site for the organization's Master Control Center (MCC). A second, related requirement was the desire to have the computers and other information sources located away from the user consoles, and ultimately remote from the room itself in a separate IT-controlled environment. Given that there could be multiple computer and data sources (one for training, one for backup control) per display, this requirement became even more important to avoid having too much equipment, cables, noise and heat at the user console. Yet, the customer wanted to ensure that separating the sources from the users would not in any way deteriorate the user experience by lowering video resolution quality or creating keyboard or mouse latency. This was especially important for the training operation. The simulated user experience should be as authentic as possible when compared with the Master Control Center environment. Making this requirement even more stringent was the customer's specification for high-resolution video formats such as dual-link DVI. System availability was a third, important requirement. As a Backup Control Center, safeguards were required in the design and implementation to ensure continuous operation, even in the event of isolated equipment failures. Finally, the center and its systems needed to comply with North American Electric Reliability Corporation's Critical Infrastructure Protection (NERC-CIP) standards for reliability and security.

To achieve the customer's first and primary objective -- the ability to quickly switch the use of their new center from training to backup control a high-end KVM architecture was chosen. In this architecture, the sources (computers, network data, Blu-ray players, etc.) are separated from the displays, keyboards and other peripherals by some distance, and located in a separate, IT-controlled environment outside of the user work area. The A typical high-end KVM system infrastructure relays (or extends) the video data for displays, as well as the keystroke and mouse movement data for computer peripherals, from the source to the display or peripheral, over a greater distance than typically allowed under the individual signal standards. For instance, where a typical cable for DVI video might be 15 feet long, A typical high-end KVM system can "extend" a DVI signal up to 50 miles. This is the key to allow the computer and data sources to be removed from the room without compromising performance.

More importantly, in the system's switched KVM architecture, each source is connected to a KVM system matrix switch, as well as each destination (display, keyboard, mouse, etc.). With this configuration, any source can be switched to any destination at any time. This is how the customer achieves their requirement for fast switchover of the facility from training to backup control. At one moment a user's console of several displays might be filled with training information. With a simple "flip of a switch" using control management software, the console's displays will be filled with the desired backup control information from a new set of sources – all in the time it takes for the displays to reset, typically in one or two seconds.

BCC complies with NERC-CIP standards and allows for full activation and redundant operation in the event of an evacuation of the Main Control Center. The A typical high-end KVM system KVM system allows for easy and secure switching of video, data, and computer peripherals between simulation environments and data center activation with no latency or loss of performance, and redundancy where needed to maintain maximum uptime. The system is also flexible and modular to adapt to future changes in the customer's staff, operational or technology requirements without extensive modification.

5 CONCLUSIONS

The Experience of other industries with KVM Wall panel displays present significant opportunities to enhance the control and management of nuclear power plants. Applications in both operating and advanced plants can help organizations securely manage video-rich workflows, leading to instant situational awareness, increased productivity and lower operational costs. Potential enhancements include:

- Further HFE Task Simplification
- Computerized Procedures
- Enhanced Cyber Security
- Enhanced Fire Protection
- Flexible Layout
- On-site Off-site linkage

6 ACKNOWLEDGMENT

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