Case Study: Integrated Racks for Air Traffic Control

Background

Steatite was asked to develop a custom integrated rack for Air Traffic Control (ATC) equipment to be used at military airfields around the world. The solution was part of a larger project including control tower equipment, radar displays, communication systems and navigation aids.

The Challenge

The project was particularly technically challenging due to its deployment in remote, unmanned environments. Additionally, reliability and ease of maintenance were key considerations in the project.

System integrity and redundancy

In traditional ATC environments, controllers have a direct “out-of-the-window” visual backup in case of equipment failure. Remote (or ‘virtual’) towers, however, depend entirely on a functioning system, making any system failures a critical risk. For this, equipment must be highly reliable and feature robust backup systems to ensure uninterrupted service.

Remote maintenance

Technicians are not onsite in remote, unmanned locations, making maintenance and repairs difficult. This requires systems to be highly durable and have self-diagnostic capabilities. The rackmount equipment for this application had to withstand extreme environmental conditions and be quickly interchangeable with the use of Line Replaceable Units (LRUs).

Data transmission and latency

Remote towers rely exclusively on camera feeds, lacking direct visual and auditory cues that controllers depend on for real-time decision making. Such installations are reliant upon real-time transmission of large amounts of data to a centralised control centre. This demands high-capacity, low-latency communication networks. Any delay, even for a fraction of a second, can compromise a controller's ability to respond quickly to a dynamic situation and increase collision risk.

Cybersecurity risks

Remote ATC equipment is increasingly becoming a target for cyberattacks. A successful attack, such as data manipulation or a denial-of-service attack, could compromise safety-critical information and disrupt operations. We had to be aware of these stringent cybersecurity protocols.

The Solution

This design incorporated specialised radio equipment, military GPS, and associated hardware, as well as the specification of a UPS solution to maintain the equipment in an operational state during power outages. Custom designed cooling trays, power distribution and external connectivity panels were also part of our solution, with the racks' internal cabling being designed and installed by Steatite.

The racks were subject to stringent EMC requirements, requiring the use of high-performance gaskets and door seals, as well as welded seams and fully bonded external panels.

Partner with Experts who Understand Complexity

Steatite has extensive experience designing rack solutions for both military and commercial environments. This includes ruggedisation of components, LRUs and rack hardware to meet a range of harsh environmental and EMC specifications.

All rack cabling design, manufacture and installation is carried out in accordance with IPC/WHMA-A-620 class 3, with in-house IPC qualified technicians, inspectors and engineers.

For some applications, such as the one mentioned here, custom cooling solutions are needed to ensure equipment remains within its operating temperature range within the rack, whilst maintaining EMC performance of the system. We design systems to align precisely with customer requirements, which may include specialist slide rails, fan trays, door solutions or compartments.

LRUs designed and supplied by Steatite for rack mounting include rugged rackmount computers, resilient timing systems, and KVM solutions, with slide-out keyboard/display assemblies, each put through an extensive range of testing, including EMC, thermal and shock and vibration. Furthermore, our KVM design has passed severe shock testing, even when open.

Custom interface panels are usually designed to ensure that I/O interfaces mate with existing cabling, sometimes with specialist military connectors, RF connectivity, or standard commercial components.

Learn more about the integrated systems we offer and contact our team to discuss the bespoke requirements of your application.