# Open and Distributed Architecture in a Virtual Monitor Wall System

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## Abstract

A quarter of a century ago, computer pundit Herb Grosch stated what later came to be known as Grosch's law: the computing power of a CPU is proportional to the square of its price. By paying twice as much, the end user could get four times the performance. This observation fit the mainframe technology of its time quite well, and led most organizations to buy the largest single frame machine they could afford. With microprocessor technology, Grosch's law no longer holds. The end user can pay twice as much, but get the same CPU, only performing slightly better. As a result the most cost effective solution is frequently to harness a large number of CPUs together in a system.

This paper will explore the concept of an open and distributed architecture and how it is related to the monitor wall system that has become more and more popular in the broadcast, production and cable head-end environments.

## Introduction

One of the main reasons for the trend towards distributed systems in the IT world is that an open and distributed system potentially has a much better price/performance ratio than a single large centralized system would. In effect, a distributed system gives more "bang for the buck". Actually, the general observation that a collection of microprocessors can not only give a better price/performance ratio than a single mainframe, but may yield an absolute performance that no mainframe can achieve at any price. Another advantage of a distributed system over a centralized one is higher reliability. By distributing the workload over many machines, a single chip failure will bring down at most one machine, leaving the rest intact. Ideally, if 5% of the machines are down at any moment, the system should be able to continue to work with 5% loss performance.

Incremental growth is also a big plus. Often facilities will buy a system with the intention of doing all of its work on it. Once the workload grows, at a certain point the mainframe will no longer be adequate. The only solution is to either replace the mainframe with a larger one (the forklift upgrade), or add a second mainframe. Both of these can wreak major havoc with interruption to the facility's operations. In contrast, with a distributed system, it may be possible to simply add more modules/processors to the system, thus allowing it to expand gradually as the need arises. In order to answer the constant need to grow and at the same time provide the performance and reliability that is needed in a broadcast environment. Thus with these critical elements in mind, Avitech introduced its virtual monitor wall system based on its unique open and distributed architecture.

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|---|---|
| Economics<br>• Low Entry Point | Performance<br>• Multi Processing |
| Reliability<br>• No single Point of Failure | Scalability<br>• Incremental Growth |

Fig 1: The 4 major advantages of a distributed system

## Economics

It was quickly apparent with the centralized model that most virtual monitor walls had an expensive entry point. When an end user wanted to start with a single quad split and plans to expand their system in the near future, it is comparable to the IT facility manager that had to buy the largest mainframe currently available and hope the company would not out grow it too soon. A distributed system can easily allow the facility to grow at its own speed and only purchase the equipment that is needed for the task at hand, but at the same time plan for its future growth without the upfront investment.

## Performance

During the past ten years it has been evident that a system can achieve better performance by harnessing a large number of subsystems/modules (CPU). This is not only the most cost effective solution, it is also sometimes the only method that can overcome the theoretical limits of a single CPU. Applications such as a virtual monitor wall that involves large computation, but little interaction, that is, **coarse-grained parallelism** is ideal for this architecture.

## Reliability

The issue of a single point of failure becomes a major concern to many technical managers. Previously when a CRT fails, only one picture was lost, but with virtual monitor walls, more and more images are put in a single box and when that box fails the entire wall will be black. It is easy to plan for redundant routers, servers and even cameras, but what about the virtual monitor wall? It is unreasonable to ask the facility managers to purchase two virtual monitor walls to make sure that they do not have a single point of failure in this critical link of their operational chain. If there is a unfortunate failure during a live production, even hot swappable boards may not be able to respond in time.

## Scalability

Over the years, it has been proven time and time again that once a limit is set, it is not enough. Routers has been a prime example of this phenomenon. It was not long ago a 128x128 router was considered large, then 256x256, now there are 1024x1024 routers out there. This growth trend took less than 5 years. At the rate the router is growing, the monitor wall will have to grow. Every facility manager understands about purchasing a pre-wired router to allow for expansion, the same should be considered for the monitor wall.

It would be ideal if the system is flexible enough that input modules can be added while the system is still online. This online expansion capability has been a request to many server vendors for the playout environment. It is only reasonable to expect the same scalability from monitoring companies. There should be no limitation on how many "heads" there are in the system. Because parallel expansion (adding a display) is just as important as serial expansion (adding more images).

## MCC: A Virtual Monitor Wall System for mission critical signal monitoring

The Avitech Media Command Center (MCC) Virtual Monitor Wall module is based on the revolutionary **MEDi**™ technology that is ideal for complex processing of multiple sources that are found in broadcast centers, video production facilities, cable/satellite operations, mobile production trucks, traffic monitoring, security, broadband distribution facilities and more.

Instead of an all-in-one box, one-screen approach, MCC uses an architectural model that is suited for mission critical and dynamic environments. A variety of input modules can be mixed and matched to meet the precise requirements of any facility. The output of a group of sources is shown on a display device, typically an LCD/plasma display panel, rear projection cube, or projector.

The modular design of MCC means that facilities can optimize systems designs for present and near term use, as well as economically add capabilities as increased future monitoring needs are demanded.

The MCC is not limited to only scaling down the video, but also maximizes the screen for full video display. As an option, users may choose to drive full screen mode with the latest **DCDi™ technology** from Faroudja. The MCC delivers unparalleled full screen pictures for both HD and SD signals with this technology.

## The Distributed System

The Avitech ODiS™ (Open Distributed Integrated System) is used to define the basis of various aspects of the virtual monitor wall. The physical and data layer covers the electrical, mechanical and signal communications between all the modules/processors in the display group. Avitech has chosen industry standards such as RS-485 and DVI as the back bone of the signal and data communications.

RS-485 allows multiple devices (up to 32) to communicate at distances up to 1200 meters (4000 feet). The devices are addressable, allowing each node to be communicated to independently. RS-485 not only allows the virtual monitor wall system to be distributed in processing, it also allows the system to be distributed physically.

There are various flavors of DVI. DVI-I was chosen to allow both analog and digital signals to pass through all the MCC modules. This was a critical choice which is the ultimate foundation of the redundancy and reliability of the MCC virtual monitor wall. In case of a module failure, analog signals are

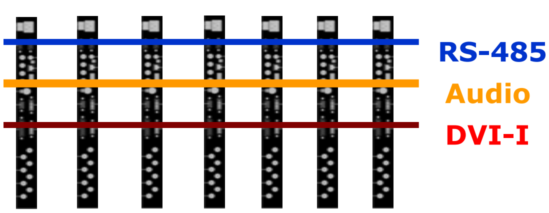


Fig 2: Video and Audio are processed in a distributed system based on DVI-I and RS485.

still passed through the failed module. Systems designed with DVI-D that do not carry the analog signal will become the point of failure.

## The Fear of Losing Everything

In the old days, signals in a facility were monitored by individual CRTs, even though the CRTs did not provide any redundancy, but the end users know that in a single event of failure, they will only lose one signal. The individual CRTs were the best example of a distributed monitoring system. However, with the digital revolution and the advent of technology, more and more signals now need to be monitored before it goes to air, individual CRTs are often no longer practical, due to space and weight constraints, not to mention the energy consumption. Suddenly, facility managers are finding themselves with all their signals in a single box and displaying them on a single screen.

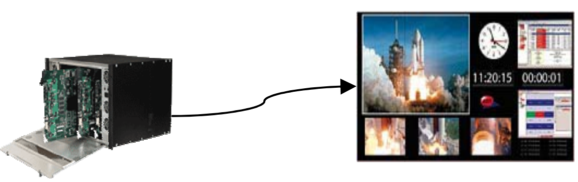


Figure 3: A single box housing all the signals with a single output.

So how is Avitech responding to this issue? Key requirements were generated to design an open and distributed virtual monitor wall system with reliability, flexibility, scalability and the highest performance in the industry. It not only provides an N+1 redundancy scheme, it also provides the user a peace of mind that there is no single point of failure and it requires minimum time to recover from a unlikely failure.

### N+1 Redundancy

How does one know that the spare boards that sit on the shelf will actually work in the event of a failure? The fire hydrant in front of the house is hardly ever tested until the house is on fire, by then it may be too late to find out there is no water. The same thing can be true with a shelf spare. The spare boards are often not tested on a regular basis, in an event of a board failure in the active frame, it can really be a leap of faith while performing the hot swap.

The revolutionary N+1/N redundancy from Avitech is designed to have the spare unit(s) already online, but in a deactivated state.
In an event of a module(s) failure, it is simply a drag and drop action to activate the spare(s). As part of the regular maintenance procedure, the spare module(s) can be tested on a regular basis.

The system is designed to have up to 60 windows (15 modules) on standby. This procedure is so simple and user friendly, it can be part of the regular maintenance procedure to test the spare without having to take any signals offline.

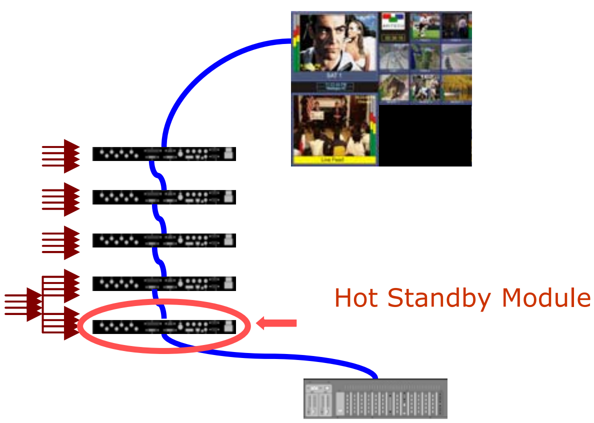


Figure 4: N+1 Redundancy to back up the most important images

## Summary

Distributed systems have a number of significant advantages. They can offer good price/performance ratios, are a good fit to distributed applications, such as multiple image processing, can make highly reliable and can be gradually increased in size as the workload grows. This is the key advantage of the Avitech ODiS™ architecture. First and foremost, it is based on the reliable and proven technology as its basis for quality and performance.

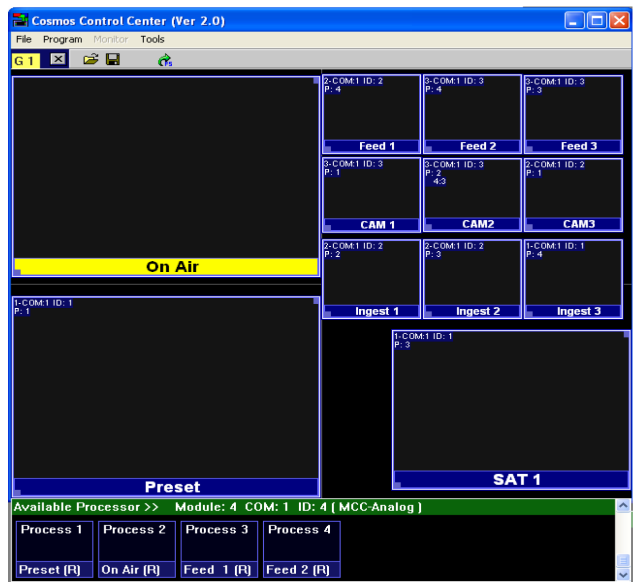


Figure 5: Simple and easy to use software user interface. Simply drag the available processors and drop them onto the online window