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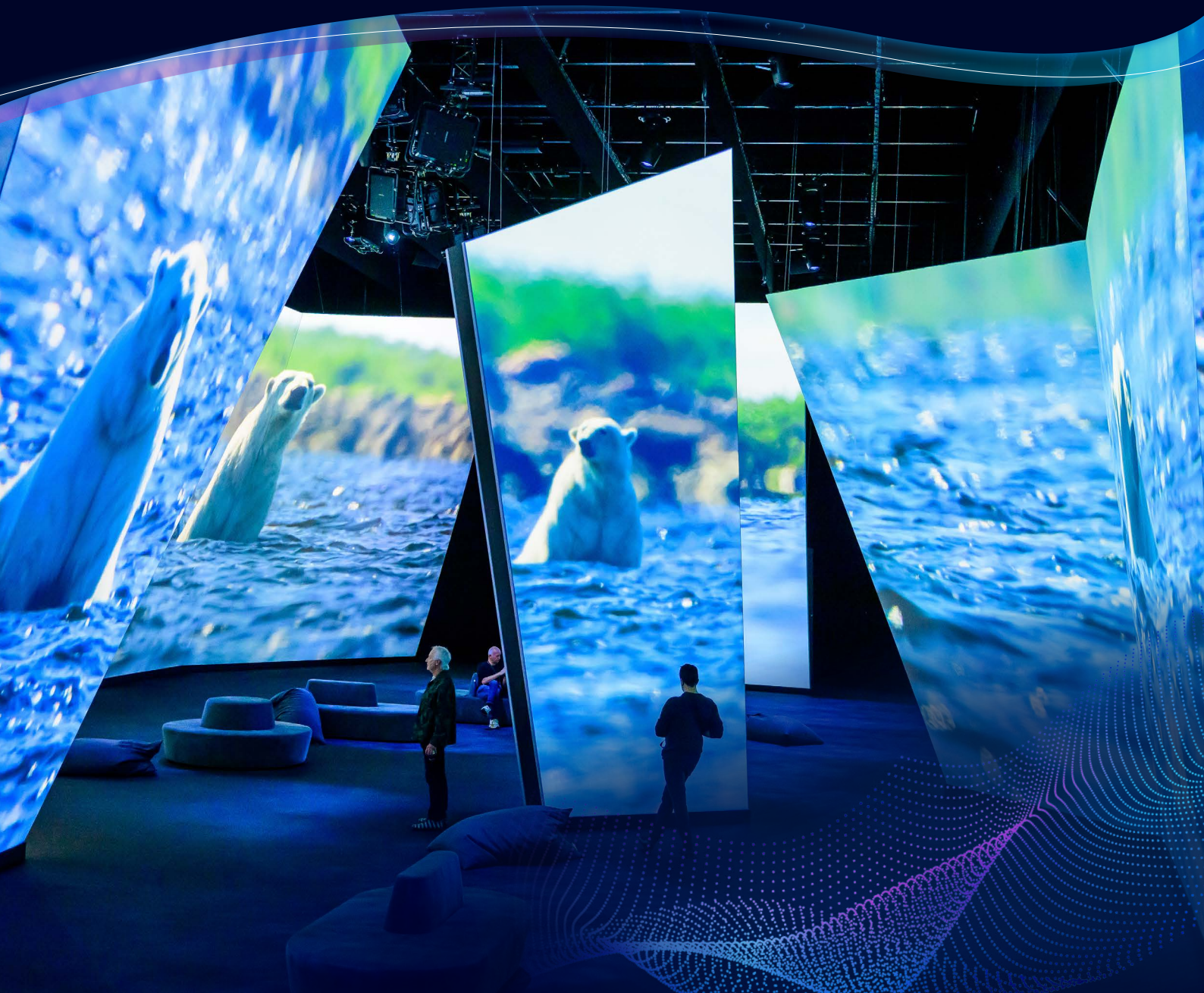
**intel**<sup>®</sup>



A WHITEPAPER PRESENTED BY PANASONIC, INTEL<sup>®</sup> AND HIVE

# REVOLUTIONISING IMMERSIVE ENTERTAINMENT DEPLOYMENTS

A new Distributed Architecture powered by Intel<sup>®</sup> Smart Display Module (Intel<sup>®</sup> SDM)



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# INTRODUCTION

As the experience economy continues to grow, the thirst for new immersive experiences has been seen across the entertainment, art and education sectors.

THE GROWTH OF IMMERSIVE EXPERIENCES REFLECTS A CULTURAL SHIFT TOWARDS MORE DYNAMIC, ENGAGING, AND PARTICIPATIVE FORMS OF ENTERTAINMENT AND EDUCATION.

In this dynamic landscape, organisations are under increasing pressure to continually enhance the quality and innovativeness of the experiences they offer to their audiences.

However, the logistical complexities of mounting such shows are immense, especially those designed to tour. One of the key challenges in this process is the technological infrastructure that underpins them. Traditionally, immersive experiences have relied on a centralised architecture, where the core

components and processing units are located in a single, often sizeable, hub. Today's demand for high quality resolution content is placing additional pressures on the signal transportation infrastructure in this architecture – making it increasingly costly, complex and fragile.

In addition, while the centralised architecture can be effective in a static installation, it poses significant challenges in a touring context. The centralised system is not only bulky and complex to disassemble and reassemble, but also incurs high transportation costs and extended setup times. These factors collectively can impede the agility and scalability of touring immersive experiences.

Recognising these challenges, technology leaders Intel®, Panasonic and Hive have worked together to create a **new distributed architecture** that represents a revolutionary step in the world of immersive entertainment deployments. This new approach, powered by [Intel® Smart Display Module \(SDM\)](#), decentralises the processing power from a single, distanced hub and distributes it across multiple nodes at the display units. By integrating the processing capabilities directly within the projectors or displays, this innovative architecture reduces the need for extensive central processing equipment.

The benefits of this shift are manifold. Firstly, it significantly **cuts down on the bulk and complexity of the equipment**, removing the need for a central media hub and reducing cabling. For touring shows, this approach makes them more agile and easier to transport. This directly translates to reduced logistical costs and shorter setup times, enabling organisers to tour more locations with greater efficiency.

Secondly, a distributed architecture offers **enhanced flexibility** in design and deployment. Initial costs are lower, as traditional larger media servers are only available in clusters with multiple outputs, meaning scaling requires larger investment steps – not unit by unit. A distributed architecture is more modular and scalable, where elements can be added, removed, or reconfigured with ease, adapting to the varying constraints and opportunities of different venues.

TO DELIVER THIS NEW SOLUTION,  
THE THREE CRITICAL TECHNOLOGY ELEMENTS  
OF PROCESSING PLATFORM, MEDIA SERVER  
AND PROJECTOR OR DISPLAY UNITS MUST BE  
INTEGRATED.

THIS WHITEPAPER EXAMINES  
HOW THE NEW ARCHITECTURE WORKS,  
THE ROLE PLAYED BY **INTEL®**, **HIVE AND  
PANASONIC**, THE BENEFITS OF  
THE NEW SOLUTION AND EXAMPLES  
OF IT IN ACTION.

# THE TRADITIONAL CENTRALISED ARCHITECTURE APPROACH



The traditional centralised architecture for an immersive experience attraction is characterised by its reliance on a central hub where the core computing and processing equipment is located.

This approach has been a staple in the design and operation of immersive experiences, particularly in fixed installations. The hub houses the primary computers, servers, and control systems responsible for managing and coordinating all aspects of the immersive experience.

This includes processing complex visual and audio content, managing interactive elements, and ensuring synchronised playback across various displays and speakers. Around this central hub, peripheral devices such as projectors, screens, speakers, lighting systems, and interactive

interfaces are networked. These devices receive their input and instructions from the central processing unit. The network typically involves a complex arrangement of cabling and hardware to ensure seamless connectivity and communication between the central hub and these peripherals.

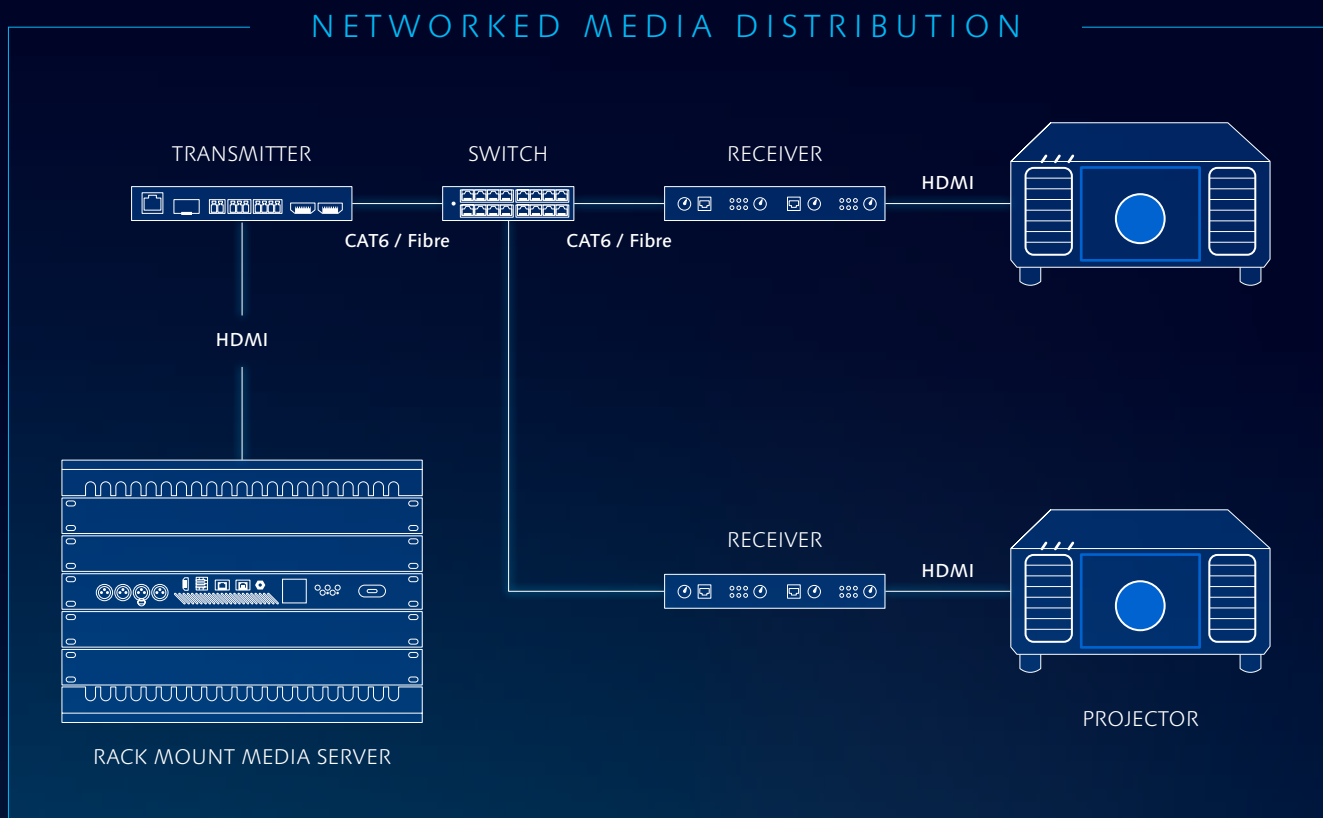
The centralised system requires **extensive infrastructure**, including dedicated rooms for equipment, substantial cabling for data and power transmission, and often complex ventilation or cooling systems to manage the heat generated by the central processing equipment.

# CHALLENGES IN SCALABILITY AND FLEXIBILITY

While this approach can be efficient for certain static installations, it poses significant challenges for **scalability and flexibility**. Expanding or modifying the experience often requires substantial changes to the central hub and the associated infrastructure. This can be time-consuming and costly, limiting the ability to quickly adapt to new technologies or content.

For touring immersive experiences, the centralised architecture presents logistical challenges. Transporting the central hub and associated equipment requires careful planning and significant resources. Setting up at a new location can be time-intensive, as it involves re-establishing the entire central system and ensuring all peripherals are correctly networked and synchronised.

In summary, the traditional centralised architecture for immersive experience attractions offers a streamlined control and management system but comes with **limitations** in terms of flexibility, scalability, and logistical efficiency, particularly for touring installations.

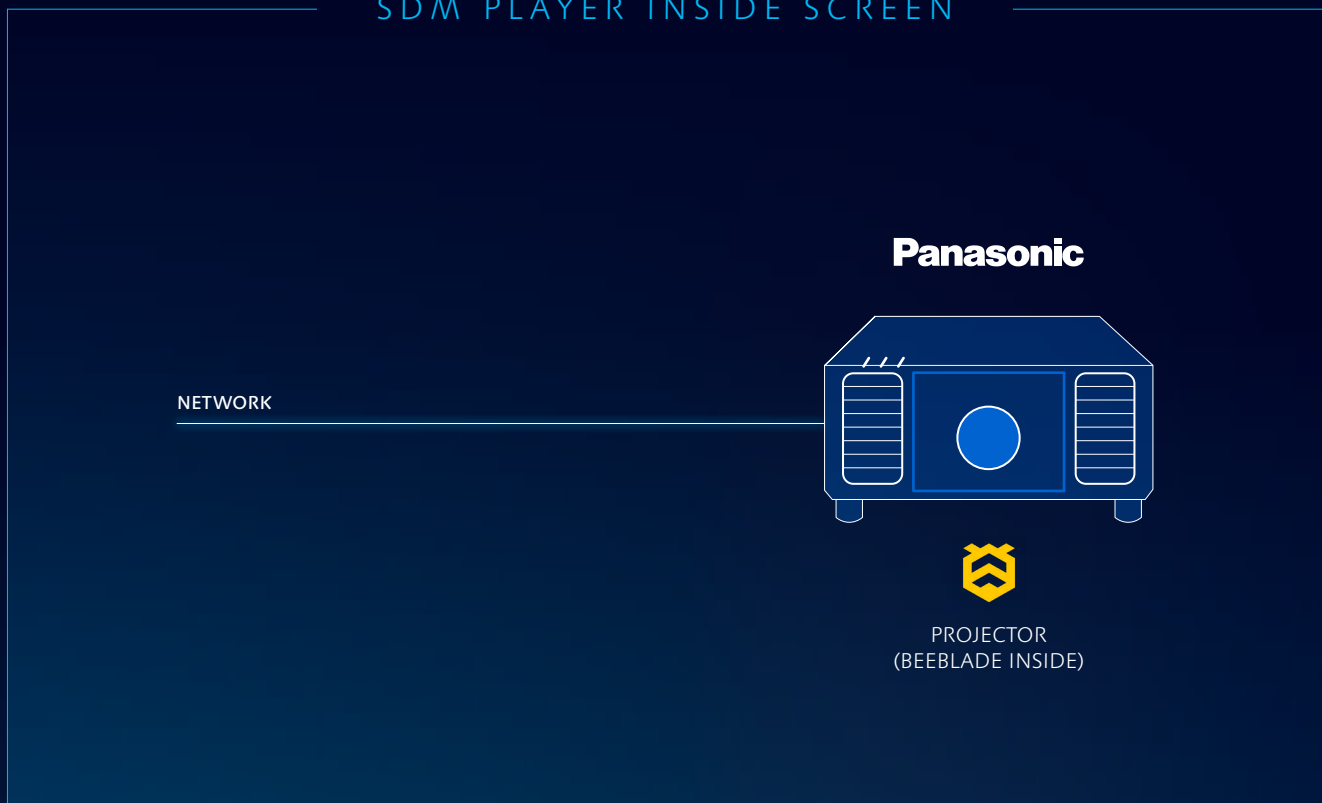


# THE NEW DISTRIBUTED ARCHITECTURE APPROACH

The new distributed architecture for immersive experiences revolutionises traditional setups by decentralising the processing elements. Using the Intel® SDM slot in Panasonic projectors, Hive has created a compact media server solution on a board, called the **BeeBlade**, which integrates directly into the Panasonic display device. Locating the media processing engine in the display device significantly reduces the need for extensive cabling and centralised control systems.

The result is a more streamlined, cost-effective, and energy-efficient setup. This system also offers **greater flexibility**, allowing for easier transportation and quicker assembly, essential for touring immersive experiences. This new model represents a significant shift towards more sustainable and adaptable media server solutions in digital storytelling and immersive experiences.

## SDM PLAYER INSIDE SCREEN



# THE THREE ESSENTIAL COMPONENTS OF THE DISTRIBUTED ARCHITECTURE



intel.

## Intel® Smart Display Module

Intel® SDM is the next generation standard that offers a compact and efficient solution for an Intelligent Display Experience. It **reduces system complexity** with modular, flexible options for different components, processors, operating systems, and types of interfaces with compatibility for an array of standards. Built using mobile SKUs from the Intel® Core processor roadmap, it provides the highest level of integrated GPU capability in Intel®'s portfolio, which is important for use cases such as immersive experiences. It minimised the need for external I/O through a custom I/O receptacle board and is future-proofed with support for 5G, Wi-Fi 6E, and display resolutions up to 8K HDR.

As an enabler of AVoIP, Intel® SDM is already being widely adopted by the AV industry for use with projectors and displays in integrated deployments, as well as, for digital signage applications and now for entertainment with immersive experiences. Designed and backed by the industry leader, Intel® SDM is a forward looking solution for the rapidly evolving needs of the AV world and display systems.

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*In collaboration with Panasonic and Hive, we are pleased to showcase how to improve the delivery of an immersive mapped content use case in this paper. Video synchronization is a crucial requirement for today's Pro AV capabilities. Demonstrating the Intel® Smart Display Module is a form factor where we see the potential to deliver power-efficient performance that enhances the scalability of the content display experience.*

*Ben Cope - Principal Engineer, Intel®*



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## Panasonic

Panasonic offers projectors and displays that are compatible with the Intel® SDM specification. The slot in its devices offers a wide range of flexibility for customers to **easily integrate their devices** using AVoIP and to add optional third party function boards that can be utilised for a wide range of applications alongside immersive experiences, such as signage and information displays. The interface board is inserted into the slot, so it does not affect the installation layout, and can be swapped out with ease.





## Hive

Hive's BeeBlade is a **compact media engine** that seamlessly integrates with video projectors and display technology through the Intel® Smart Display Module (SDM) slot, eliminating the need for a central hub and extensive cabling. The content is delivered using Hive's proprietary **BeeSync software**, ensuring perfect synchronisation of all imagery.



# OVERCOMING THE CHALLENGE OF ETHERNET VIDEO SYNCHRONISATION

One of the challenges of a distributed architecture for immersive experiences is the need for high accuracy synchronisation of content via the projectors.



Centralised architectures are inherently synchronised with dedicated cabling between the GPU cards in the central hub and the display systems. As a result, each video feed is in sync at source.

For a distributed architecture showing immersive content from multiple projectors, it is important to replicate this high level of **synchronisation accuracy** or the audience experience would be inferior with the equivalent of video jitter. It is also important to enable images and video to be shared in high quality over social media; an important marketing aspect of any immersive entertainment experience.

The industry standard approach of IEEE1588 is typically used to synchronise distributed PCs to EPOCH time. This method enables each of the SDM units to have a common

understanding of the exact point in time to start content. However, even with this synchronisation, it is not possible to guarantee the line level accuracy required for an immersive experience.

To achieve the higher line level accuracy required, Hive took open source instruction from Intel to make small modifications to the HDMI clock (equivalent to clock jitter) and to read the video timing (called V\_Blank). This innovative Beesync software enables the **exact frame time** of the distributed SDMs to be monitored and compared. If one is out of sync, then the system can automatically speed up or slowed down to compensate. Hive was responsible for the ultimate implementation of this revolutionary control loop code to track each of the systems. The solution is scalable to any number of display devices.

# THE BENEFITS OF A DISTRIBUTED ARCHITECTURE FOR IMMERSIVE EXPERIENCES

The distributed architecture implementation, using Panasonic Intel® SDM-enabled projectors and Hive's BeeBlade technology offers **numerous benefits**. This approach directly addresses challenges such as installation cost reduction and operational expense management, offering a streamlined, efficient solution for immersive installations.

## REDUCED INSTALLATION COMPLEXITY

TRADITIONAL CENTRALISED ARCHITECTURES REQUIRE EXTENSIVE SIGNAL CABLING AND A DESIGNATED SPACE FOR SERVERS. THE DISTRIBUTED APPROACH SIMPLIFIES INSTALLATION, PARTICULARLY IN NON-FIXED SETUPS, BY INTEGRATING THE MEDIA SERVER INTO DISPLAY DEVICES, **THEREBY MINIMISING CABLING AND INFRASTRUCTURE NEEDS.**

## COST-EFFECTIVENESS

A NOTABLE ADVANTAGE OF THIS DISTRIBUTED ARCHITECTURE IS A SIGNIFICANT **REDUCTION IN COSTS**. ACCORDING TO HIVE'S EXPERIENCE, TRANSITIONING FROM TRADITIONAL RACK MOUNT MEDIA SERVER SYSTEMS TO HIVE'S TECHNOLOGY CAN SAVE BETWEEN **30-40%** ON PROJECT COSTS RELATED TO INFRASTRUCTURE AND MEDIA PLAYBACK TECHNOLOGY.

## SERVICEABILITY AND UPGRADE FLEXIBILITY

THE NON-FULLY EMBEDDED NATURE OF THE INTEL® SDM IN THE PROJECTOR/DISPLAY DEVICE ENSURES THAT THE SYSTEM IS **SERVICE-ABLE AND UPGRADABLE**. THIS SEPARATION OF PC AND PROJECTOR UPGRADE CYCLES ENHANCES LONG-TERM USABILITY AND MAINTENANCE. THIS APPROACH IS ALSO IDEAL FOR THE RENTAL AND STAGING SECTOR BECAUSE IT ENABLES INTEL® SDM-ENABLED PROJECTORS AND DISPLAYS TO BE EQUIPPED AND TESTED WITH THE BEEBLADE AHEAD OF DEPLOYMENT – SAVING TIME ONSITE, SIMPLIFYING SETUPS AND REDUCING THE NUMBER OF EXPERIENCED ENGINEERS REQUIRED ON SITE.

## HIGH-PERFORMANCE PROCESSING AND MANAGEABILITY

UTILISING INTEL® CORE PROCESSORS AND INTEGRATED GRAPHICS, WHICH ARE FAMILIAR TO IT/AV PROFESSIONALS, ENSURES HIGH PERFORMANCE WITH UP TO **8K 60FPS 10-BIT VIDEO** DECODING IN A COMPACT FORM. TECHNOLOGIES LIKE INTEL® VPRO FACILITATE REMOTE MANAGEMENT AND ARE PARTICULARLY USEFUL FOR DEVICES INSTALLED IN HARD-TO-REACH LOCATIONS, SUCH AS HIGH WALLS AND CEILINGS.

## SUSTAINABILITY BENEFITS

THE SUSTAINABILITY BENEFITS OF THIS DISTRIBUTED ARCHITECTURE ARE SIGNIFICANT. THE REDUCED POWER CONSUMPTION OF THE DEVICES, LOWER TRANSPORTATION COSTS DUE TO THE ELIMINATION OF BULKY CENTRAL HUBS AS WELL AS REMOVING THE NEED FOR AIR CONDITIONING AND THE ASSOCIATED POWER CONSUMPTION, AND THE STREAMLINED SETUP PROCESS ALL CONTRIBUTES TO A **GREENER AND MORE SUSTAINABLE OPERATION**. FURTHERMORE, THE MODULAR NATURE OF THE SYSTEM MEANS THAT IT CAN BE EASILY **SCALED AND ADAPTED** TO DIFFERENT VENUES WITHOUT THE NEED FOR SUBSTANTIAL INFRASTRUCTURE CHANGES.

In conclusion, the new distributed architecture powered by Hive and Panasonic's Intel® SDM-enabled projectors is revolutionizing the way immersive experiences are created and toured. By addressing the historical challenges of central media control rooms and extensive cabling, this approach offers a more sustainable, cost-effective, and flexible solution.

The potential of this technology demonstrates the possibility to deliver **high-quality immersive experiences** while also being mindful of environmental and logistical impacts. As the demand for immersive experiences continues to grow, this innovative approach will undoubtedly play a crucial role in shaping the future of the industry.



*Panasonic's integration of the Intel® SDM slot offers unseen advantages beyond the obvious ones. The combination of enhanced reliability, minimized CO<sub>2</sub> footprint, reduced shipping costs, and the ability to combine both products upfront are just a few of the key benefits of our partnership with Intel® and Hive. This innovation marks a significant move towards sustainable and adaptable media server solutions in digital storytelling and immersive experiences.*

**Hartmut Kulesa** - European Marketing Manager for Visual System Solutions at Panasonic Connect Europe

# THE DISTRIBUTED ARCHITECTURE IN ACTION



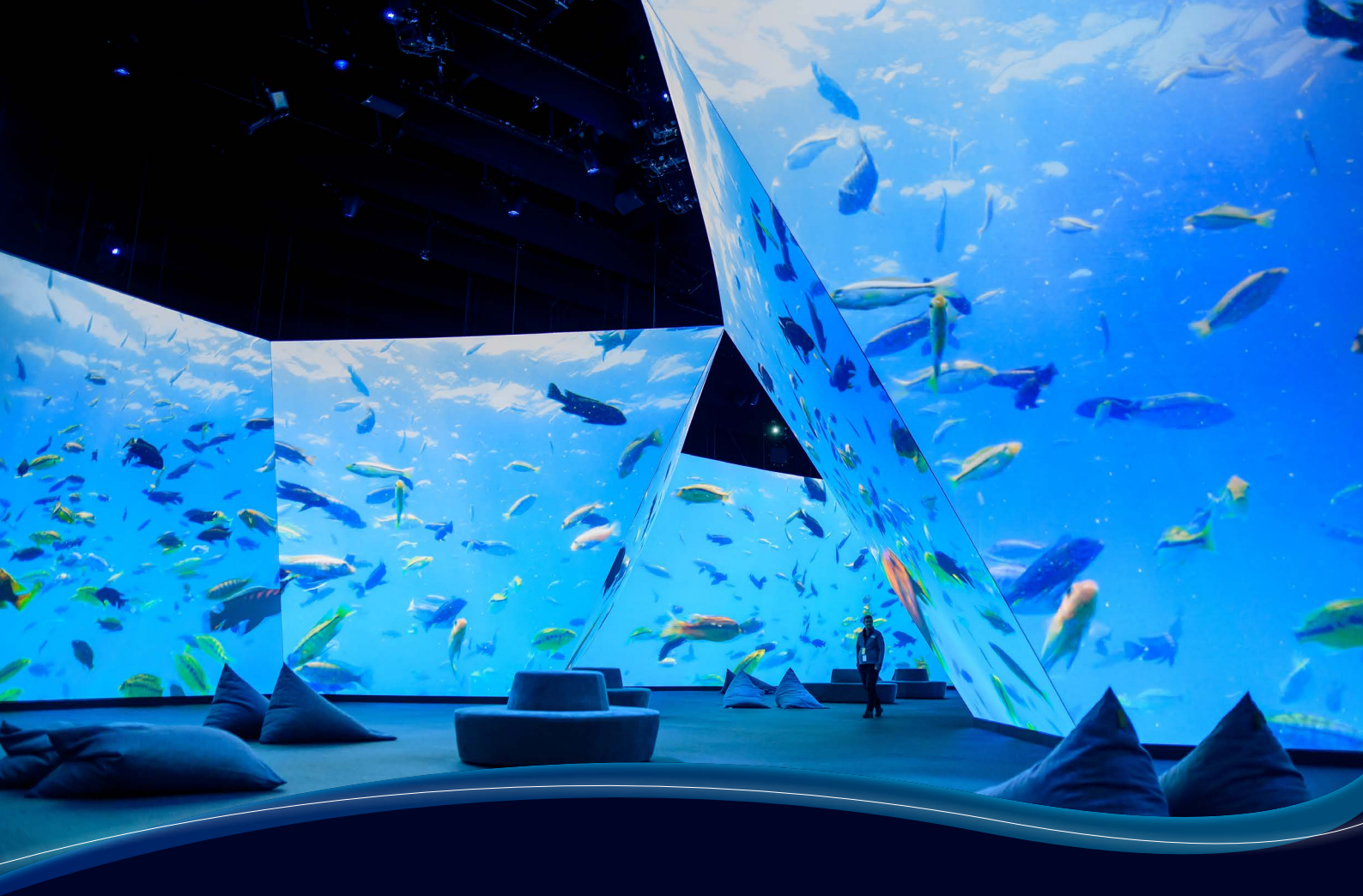
## The BBC Earth Experience in Melbourne

BBC Earth Experience is an immersive exhibition that promises to transport visitors on a journey through the natural world, narrated by legendary natural historian David Attenborough. Following the popularity of the inaugural BBC Earth Experience in London, the attraction has recently opened a second site at the Melbourne Convention and Exhibition Centre.

What sets Melbourne's BBC Earth Experience apart is the playback technology used for this installation. Leading Australian video technology and production supplier, TDC, chose a **distributed architecture solution**

for the first time in a major deployment, using **Hive's BeeBlade media server** on a board in **Panasonic Intel® SDM-enabled projectors**.

The exhibit is equipped with 70 Panasonic projectors, with 55 creating the main immersive space, 49 of which are powered by BeeBlade. The content is delivered using Hive's proprietary BeeSync software, ensuring perfect synchronisation of all imagery. In the main room, there's a 360-degree experience with over 127 million pixels. The Beesync software ensures every pixel in the right place at the right time.



The deployment removed the need for a central hub, saving time on set-up, money on cabling and **reducing the overall space and environmental impact** of the immersive experience, which was very important to the ethos of the organisers.

*"The distributed approach has less impact on the environment in a number of ways,"* explains Dave Green, at Hive. *"First, the power consumption. Only 65 watts per device, which for the equivalent media server could often be 10 times that consumption. Then there are a number of addi-*

*tional benefits, such as the weight in the transportation of the equipment. There are no big racks. The systems are easily supported remotely. Overall, they're just designed in a modern, compact, efficient manner."*

*"The BeeBlade doesn't just represent technological advancement,"* said Michael Hassett, managing Director at TDC. *"They are harbingers of a new, greener, and more efficient era in digital art installations. This transformative approach is not just a disruption in the media server space; it's an evolutionary leap, saving time, money and the planet."*

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*The BBC Earth Experience Melbourne is the perfect environment for our range of SDM BeeBlade products. The Hive product range aligns with the environmental narrative, all our products meet strict guidelines from the BBC & Mooneye Productions to take responsibility and cut CO<sub>2</sub> emissions, and most importantly to the experience - the full Hive range of products - BeeBlade, Beebox & Beehive provide rock solid reliable silky smooth playback to the immersive show, day in, day out. We are very happy to see over 90 of our products deployed and to see them performing HDMI frame accurate sync using our proprietary BeeSync technology. Our whole Hive team are all immensely proud of the BBC Earth Experience Melbourne and I am eternally grateful to our growing teams ongoing dedication to our brighter vision to revolutionise video playback for the industry we love.*

**Mark Calvert** - Managing Director at Hive

## Art of Sistine Chapel brought to life for visitors unable to visit Rome

Until recently, Michelangelo's famous work in the Sistine Chapel could only be experienced in person with a visit to Rome. However, this incredible visual spectacle has now been recreated in an immersive experience using a distributed architecture approach with Hive's BeeBlade media server on a board in Panasonic Intel® SDM-enabled projectors.

Spread over three halls in the grounds of Warsaw's PGE National Stadium, the exhibition – titled *"The Sistine Chapel Heritage"* – is an all-encompassing journey through some of history's most referenced paintings and sculptures.

Polish AV integrators ARAM headed up the complex installation, opting for **39 Hive BeeBlades inside Panaso-**

**nic Intel® SDM compatible projectors** and three BeeBoxes that powered LED walls.

When guests arrive at Sistine Chapel Heritage, the first room that they enter explores the era of Renaissance art. The second space, known as the Cinema Hall, shows the Sistine Chapel and pioneers of the movement across a huge 19-metre LED screen. The third room is where visitors become completely immersed in the chapel via state-of-the-art visual technology. It's all powered by BeeBlade, Hive's cost-effective solution for media control, placed inside Panasonic projectors, integrating Hive Media Player BeeSync solutions and easy-to-use software into the display hardware and eliminating the need for any complex signal distribution networks.



# CONCLUSION



THIS LATEST DISTRIBUTED ARCHITECTURE APPROACH IS AN IDEAL ALTERNATIVE TO THE TRADITIONAL CENTRALISED ARCHITECTURE USED FOR IMMERSIVE EXPERIENCES IN MANY COMMON SITUATIONS.

For attractions that tour, the approach saves time on installation and decommissioning, cuts costs on cabling, operation and transportation and reduces the need for experienced engineers on site. For attractions with limited space, this approach also offers benefits by removing the need for a central control hub. Moving forward, it is a significant advancement in the deployment of immersive experiences and another effective use of the Intel® SDM infrastructure in the AV industry.



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how a distributed architecture can transform your vision.

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