

Casambi Whitepaper

Wireless lighting control for: Art and Culture



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CASAMBI

Introduction

It is undeniable that art and culture are key drivers of social change. Museums and cultural spaces house memories of knowledge - a history of who we are - that informs us as we move forward. By protecting such institutions, we are safeguarding our cultural and natural heritage, supporting education and research. These efforts closely align with the UN's Sustainable Development Goals¹.

According to UNESCO, there are around 104,000 museums across the world - over 8,000 of which are directly linked to World Heritage sites². The sector is huge and expansive. Then COVID-19 hit hard, posing an existential threat to many. Urgent closures in 2020, and again in 2021, resulted in a 70%-average drop in attendance and a 40-60% decline in revenue compared to 2019³.

However, through adversity came opportunity. The pandemic incentivized the development of unique solutions, the adoption of new technologies, the acceleration of digital transformation and a radical rethinking of the future. The sector understood the need for a more user-centric approach and concepts like “experience”, “interactivity” and “engagement” represent this new period⁴.

Museums and cultural spaces - whether their focus is on art, science or history – are seeking to create an interesting and visually-appealing experience. It is here that lighting plays an important role: a good and correct lighting design will exalt the masterpiece, enhance the intricate details of an item on display, evoke emotional resonance, all while simultaneously protecting the artefact from light damage.

Appropriate luminaires in association with an intelligent lighting control system can be used to ensure that illuminance levels, brightness and color temperature are always adjusted to suit the specific needs of a particular exhibition.

Casambi's wireless lighting control technology is contributing significantly to a modern-day revolution in how we display our historical locations and works of art because its solution is unconstrained by fixed controllers, cables, and complicated proprietary software. All the while giving the programmer freedom of movement to examine, assess and articulate their artistic vision for and of a masterpiece⁵.

1. “The Sustainable Development Goals: Helping Transform our World Through Museums”. ICOM. January 21, 2020. <https://icom-museum/en/news/the-sustainable-development-goals-helping-transform-our-world-through-museums/>

2. UNESCO. accessed November 2022. <https://www.unesco.org/en/museums>

3. “Museums around the world in the face of COVID-19”. UNESCO report. 2021.

4. “Museums: Trends and Digital Strategies: Art, Culture and New Technologies in Latin America and the Caribbean”. Vargas Santiago, Luis. IDB. 2022. <https://publications-iadb.org/en/museums-trends-and-digital-strategies-art-culture-and-new-technologies-latin-america-and-caribbean>

5. “Part One: Do you need to love art to light art?”. Tribe, Cliffe. Casambi blog post. July, 2022. <https://casambi.com/blog/part-one-do-you-need-to-love-art-to-light-art/>

Casambi brings many benefits not only for the artwork but also for the exhibition space itself. The system allows the setting of lighting control scenes, dimming of illuminance levels, activation of lighting in response to presence detection, the use of daylight, controlling of blinds - to mention but a few of its capabilities. By using only the right light in the right place at the right time, this also contributes to energy conservation and maintenance cost reductions.

This guide outlines how Casambi's wireless lighting control solution is aligned with the trends and dynamics of this sector, and demonstrates how it can enhance the lighting within spaces dedicated to art and culture, while bringing further benefits beyond illumination.

Key drivers and trends

Moving forward, cultural institutions are reinventing themselves, and looking for innovative and creative solutions along the way. Here are three key trends:

Flexible design is the present and future

Flexibility affords more freedom when installing temporary exhibitions. An exhibition space must provide all the infrastructure, including lighting and lighting control systems that are adaptable to each unique exhibition⁶.

Secondly, cultural spaces are becoming more versatile and providing experiences to visitors from widely varying backgrounds⁷. They are no longer buildings that simply display and preserve collections, their physical spaces are being used as venues for conferences, courses, meetups, and so on. Little by little they are converting to egalitarian places where people can gather, chat and exchange experiences.

Outdoor events are telling new stories

Open-air programs existed before the pandemic, however, virus-induced health and safety concerns are making them all the more popular as an alternative for people who are still hesitant about gathering in indoor areas⁸.

Outdoor events and exhibitions are becoming a new normal. In the coming years, outside areas will be renovated to offer a wider range of attractions and facilities⁹.

6. "Making visible what the artist intended – Museum lighting solution". Philips brochure

7. "Design forecast 2022". Gensler

8. "Taking the Museum Experience Outdoors". The New York Times article: April, 2022. <https://www.nytimes.com/2022/04/27/arts/design/outdoor-museum-experiences.html>

9. "Design forecast 2022". Gensler.

User-centric approach

Cultural institutions realize that their mission must include and be focused on their visitors – whether they attend in person or online.

It is important to diagnose who exactly ‘they’ are. This is because the audience is diversifying and ever-changing. Digital transformation and new technologies enable institutions to cross boundaries and reach visitors who have not been on their radar before.

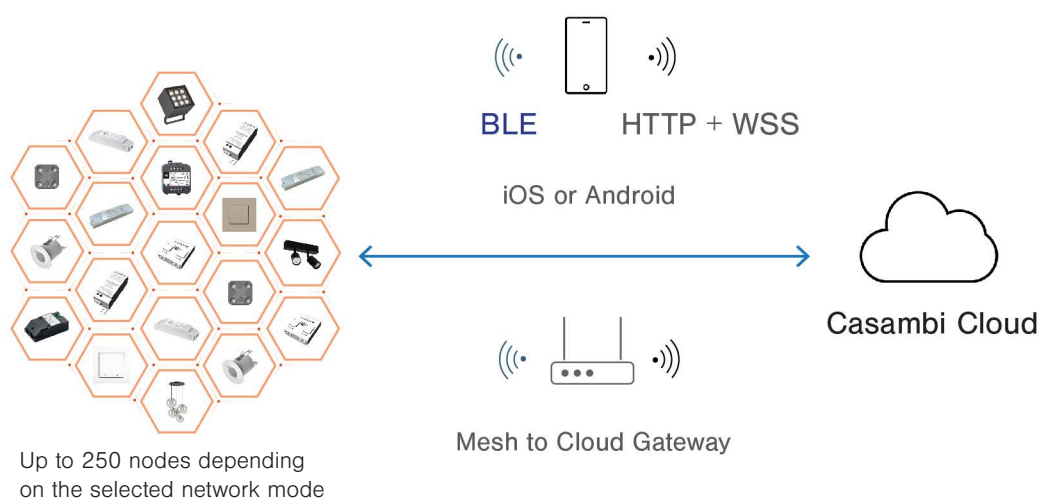
Augmented reality and virtual reality are increasingly incorporated into exhibits, alongside voice command, museum apps, artificial intelligence, 3D digitalization, and other gadgetry capable of utilizing content in a more immersive way to create new visitor experiences.

How it works

Casambi’s Bluetooth Low Energy-based mesh technology provides lighting designers and manufacturers with the ability to wirelessly link devices together enabling the creation of customizable smart lighting networks.

Essentially luminaires, switches and sensors gain Casambi connectivity by either incorporating Casambi chips or by using Casambi’s external Bluetooth modules. Minimal hardware is required. No cables, no internet, no routers are needed to run a network.

Mesh networking is essentially a low-latency, low-power mesh network protocol, which in layman’s terms translates to a fast, battery-life-extending, and highly reliable connection. Mesh networks are self-healing. If one smart device in the network suddenly becomes unavailable, in a mesh network, signal flow automatically reroutes through other devices, increasing reliability through multiple nodes and redundancy of nodes. There is no single point of failure. Every single device in the system contains the same, full intelligence of the network, eliminating the need for additional controllers, gateways, or hubs. The larger the lighting network, the stronger the mesh.



Casambi wireless mesh network with internet gateway

Casambi benefits for museums and heritage sites

Casambi caters well to today's museums, historical buildings and heritage sites by directly answering the need for powerful, highly customizable lighting control. Such benefits include:

Flexibility

- With Casambi's wireless lighting control solution, everything can be rewired in the software. Control groups, light scenes, automation programming can be created and changed time and again without having to consider any physical communication cables, as per a traditional wired system. It is important in this kind of space because room partitions, temporary exhibitions and preferences may change.

'The [wireless] control system allows us to walk into a space with an exhibition manager who can point to a picture and say 'we want that one brighter' and we can do it from the ground in seconds. Whereas before, we'd have to pull lots of equipment in, which caused a lot of hassle' says Dan Gunning, AV Exhibitions Manager at the Royal Academy.

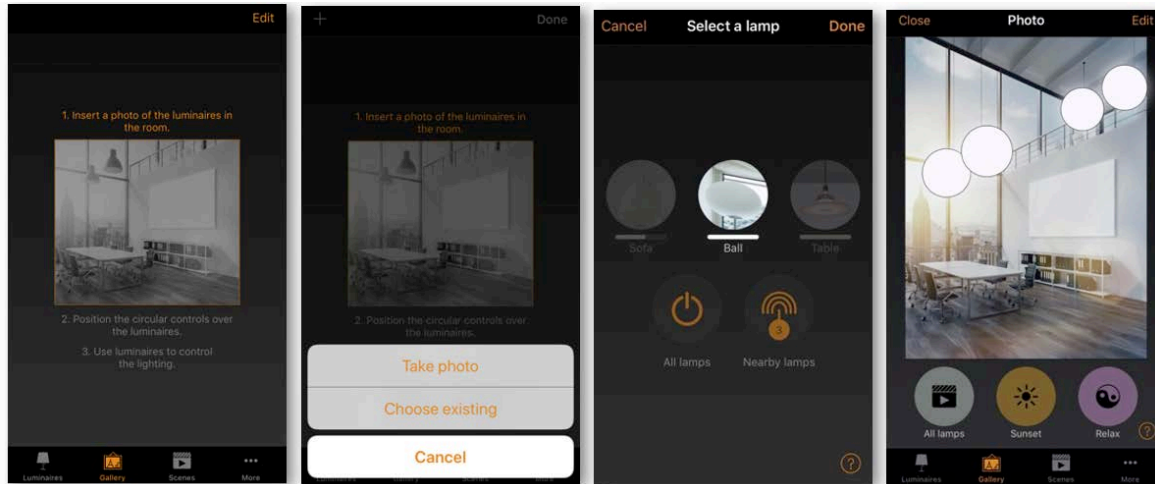
- **Non-disruptive installation:** Wireless lighting can be installed without the need for surface reconstruction or the pulling of wires, resulting in faster installation. This is so important for the conservation of architecture and historical, difficult-to-replace construction material.
- **Full functionality and customization:** Personalized circadian profiles, custom daylight modes, schedules, time-based scenes and animations can be programmed.
- **Task tuning:** Lighting can be adjusted to the optimal level for individual areas improving safety and saving energy across a site. In addition to public galleries, many museums offer storage for collections and provide other commercial areas such as shops and cafeterias adjacent to libraries and workshopping areas. Each of these areas has its own unique lighting requirements, for which Casambi can help to achieve the best result.

Easy to operate and maintain

- **Intuitive interface on mobile devices:** The Casambi App has been designed by user interface experts with one core principle; regardless of technical proficiency, anyone can use it. Luminaires can be controlled remotely, and easily reconfigured and recommissioned from a smart device.

'Final installations would take up to a week. We'd spend days and days worrying about lighting levels and now we can do it in seconds on our phone' says Dan Gunning, AV Exhibitions Manager at the Royal Academy.

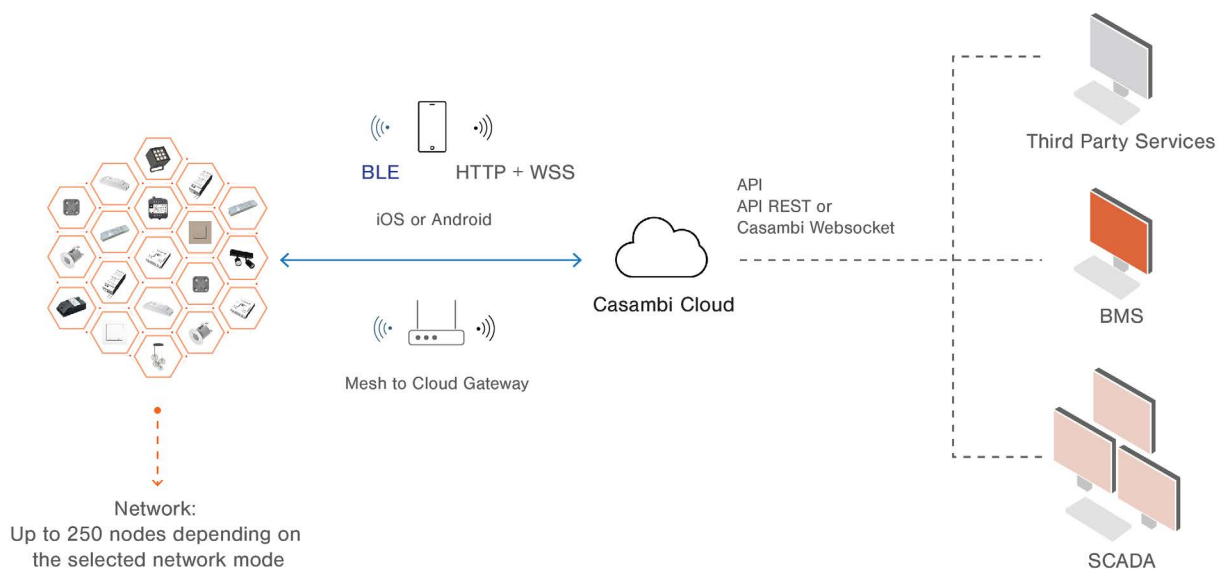
- **Gallery:** The Casambi App's Gallery feature allows you to upload photos of a space, or a floor plan, and mark the positions of the luminaires within the images. This helps to visually identify and intuitively interact with them - lightening the workload for technical staff. The curator and lighting specialist, for example, can look at a displayed work in one lighting scene versus the other just by controlling the lighting from a picture.



- **Saving energy:** By providing just the right amount of light when and where it is needed, it becomes possible to reduce energy consumption without compromising on aesthetics. Significant energy savings can be achieved in back of house areas using a multiple control strategy combining occupancy detection and daylight responsive controls. With Casambi, any existing light installation can be upgraded to include wireless occupancy and daylight sensors. Controlled lamps work in lower temperatures and emit less heat, resulting in HVAC energy savings too - especially during the summer months.
- **Environmental monitoring:** Connected lighting can be used as an onramp for other applications such as remote air quality control or noise pollution monitoring.
- **Reduced operation and maintenance costs:** No controllers nor any special software licenses are required to use Casambi control. And in case of temporary exhibitions, it is possible to save on the cost of recommissioning when the facility management team can handle all the lighting changes themselves. The remote control of lighting levels helps to extend the luminaires' lifespan, which translates to fewer lamp replacements and additional labour maintenance savings – saving on the time and effort it takes to climb up, and switch out the lamp.
- **Remote access:** Some heritage sites are difficult to access or are not manned by staff 100% of the time. Casambi provides remote access for controlling, maintaining and troubleshooting any issues - remotely implementing the best possible solution to fix them.

Using data to enhance visitor experience

- **iBeacon:** Casambi supports iBeacon profiles for those seeking a fully connected experience based on location awareness. iBeacon profiles are embedded into each Casambi device, helping to track the experience of visitors and extract knowledge from the use of physical space. Usage of iBeacon signals requires a third-party software integration that can be offered by Casambi ecosystem partners.
- **Open platform to monitor lighting fixtures:** Casambi offers a Cloud API, which allows software developers to integrate Casambi networks into third-party dashboards and applications, and in doing so, opening the doors to remote monitoring, diagnostics and usage data extraction from a lighting installation. It's possible to monitor and visualize all data from a Casambi network, such as energy consumption. Other possibilities include the collection of sensor information and processing this to generate insights such as heatmaps that display the movement patterns of visitors around the exhibition space.



Casambi BMS integration via Cloud/API

Transforming outdoor spaces

- Open air museums and exhibitions can occupy large, vast areas. By introducing a wireless lighting control system to make the lighting installation of such areas smarter and save energy, both time and material costs are minimized. For exterior lighting it is also important to minimize light pollution while preventing glare, spilling light and over-illumination known to detrimentally harm local biodiversity. Casambi enables the precision-tuning of luminosity and color temperature as night falls.
- Façade lighting plays an important role in making a building look more attractive by highlighting fascinating architectural features, and sometimes transforming a building into a landmark. The Casambi lighting control system allows the creation of static and dynamic scenes, becoming a perfect solution for façades. It is possible to play with colors (RGBW luminaires), set up light levels and fade times. Specific scenes can be programmed to turn on in alignment with special dates.

Sample application: Scenes

Each cultural building has its own multifarious lighting control requirements. With Casambi up to 255 scenes can be created per network. Each space will demand different scenes. As an example, for an exhibition room three simple scenes can be considered:

- **Open hours for visitors:** Artwork-lighting luminaires are individually programmable and are set to levels that best reflect the curator's and artist's vision. Circulation lighting is dimmed up to accomplish the levels determined by local regulations.
- **Cleaning:** Circulation lighting levels are turned up for cleaning activities.
- **Security:** Selected luminaires identified for circulation lighting are dimmed to 20% when the exhibition area is closed, based on timers. On top of time based changes, occupancy detection can also be introduced after closing hours.

A special scene or animation can be programmed for a specific artwork with the aim of creating an experience. For the 'Rembrandt's Light' exhibition at the Dulwich Picture Gallery, visitors were invited into a dimly lit, intimate gallery space that housed a single painting. Encouraged to sit on a bench, visitors could watch as a carefully programmed animation scene, on a one-minute loop from zero to one hundred percent, illuminated the beautiful and completely enchanting 'Christ and St. Mary Magdalen at the Tomb'. By programming a 'cascading' animation scene in the Casambi App, light highlighted the biblical story behind the masterpiece. In one instance, the light perfectly blended with the chiaroscuro effect to reimagine the sun rising over Jerusalem. For the first time probably ever, the 'Christ and St. Mary Magdalen at the Tomb' was bathed in 100% artificial illumination – if just for a few seconds only¹⁰.

Casambi benefits for design and installations

Whatever the theme of an exhibition, natural and/or artificial lighting is used not only to highlight the artwork, but to encourage the right approach to exploring it in alignment with the artist's original intentions.

Installations, especially temporary ones, often bring a particular challenge to the setting up of holistic lighting concepts within and for a very short timeframe. With the user-friendly Casambi App comes rapid commissioning. It is possible to play around with the settings, dim LED light sources, define color temperature, set up scenes and animations, and much more.

Another important value proposition behind Casambi's offering is that it is based on Bluetooth Low Energy and therefore does not depend on an internet connection to work. If the local Wi-Fi network fails, the design or installation lights will not be affected.

¹⁰. "Part Three: Do you need to love art to light art?". Tribe Cliffe Casambi blog post: November, 2022. <https://casambi.com/blog/part-three-do-you-need-to-love-art-to-light-art/>

Casambi X DALI

Casambi offers users unparalleled flexibility with wireless, wired, and hybrid options. Whether leveraging entirely wireless capabilities or opting for traditionally trusted wired solutions, users can effortlessly mix and match to tailor lighting networks to specific project requirements.

A hybrid solution might entail control of luminaires through wired DALI means alongside wireless Casambi Ecosystem products in the same lighting controls system. This adaptability ensures that Casambi remains applicable across diverse settings, empowering users to choose the most fitting configuration for their needs.

The latest addition to Casambi's DALI integration options, Salvador seamlessly integrates wired DALI drivers into the Casambi system, with a single unit capable of controlling up to 64 DALI drivers. DALI luminaires, when incorporated, will appear in the Casambi network as virtual luminaires, where they are programmed and controlled in the same way as Casambi Ready devices via the Casambi App. Salvador enables the extension of existing DALI networks and the creation of hybrid networks that consist of both Casambi Ready and DALI devices. Multiple Salvadors that are controlling DALI luminaires can be wirelessly connected to form a single Casambi mesh network. Notably, this product supports industry standards such as DALI D4i, DALI DT6, and DALI DT8. Additionally, Salvador features an integrated power supply, an internal Real-time clock (RTC) with backup energy storage, and cable strain relief to facilitate a smooth installation process.

Wireless emergency lighting

Modern emergency lighting systems must meet strict maintenance and testing requirements, including advanced control and communication functions.

There are several wireless emergency lighting solutions based on Casambi technology. These systems support DALI DT1 standard devices, meaning reliable interoperability with DALI self-contained emergency control gear, and enable wireless communication without the need for additional hardware or traditional DALI wiring. Emergency devices are easily paired using the Casambi App, allowing for an easy wireless upgrade for existing luminaires without a change of layout. Users can easily view the luminaires' signal strength and identify emergency devices from within the Casambi App.

These solutions provide automatic testing of individual luminaires, standard-compliant logs that available to download or access from cloud, and central monitoring via iPad or PC-based graphical user interfaces.

For more information on the wireless emergency systems based on Casambi technology, please refer to the Ecosystem section inside Casambi website.

Case studies

Casambi is a great lighting control solution for museums, art galleries, archeological sites and historical buildings. Our technology is tried and tested, and fast becoming the de facto standard in Europe.

To date, over 4 million Casambi Ready devices have been sold worldwide. Casambi has been specified in over 150,000 projects, spanning every application from small high-end residential to 10,000+ node industrial spaces. In addition to our Finland HQ, we have established regional headquarters in North America and APAC regions to serve our global networks. Casambi is deployed in highly sensitive environments, such as in hospitals and airport control towers. Our system is robust in design and has been certified as cyber-secure in accordance with global standards.

Museo dell'Ara Pacis, Rome

The original lighting concept for the Altar of Augustan Peace has been converted to energy-efficient, low-maintenance LED spotlights and wallwashers, supplied by ERCO and lighting controls by Casambi.

With the help of sensors and Casambi lighting controls, the new lighting now responds accordingly: light intensity is regulated in such a way that the marble reliefs on the exterior surfaces of the altar are optimally illuminated, with the monument standing out against its surroundings in a radiant white. In addition, further pre-defined light scenes can be called up depending on the season, time of day and use of the museum.

Site: Museo dell'Ara Pacis

Location: Rome, Italy

Casambi nodes: 200



Royal Academy of Arts, London

The Royal Academy of Arts wanted to upgrade to a more efficient and longer-lasting solution, with more flexible and sophisticated controls. iGuzzini luminaires were selected with drivers from eldoLED and lighting controls by Casambi. This trio could provide for the best performance when it comes to color temperature, optics, dimming, and controlling lighting.

The Casambi control system eliminates the need to climb up onto a platform just to dim individual lights up or down. Lighting can now be controlled directly from the app and last-minute tweaks can be easily accommodated. The LED luminaires can be dimmed all the way to 0.1% so that exactly the right light level can be achieved for every artwork. The team can also automate the lighting with pre-set scenes and timers, opening up new possibilities.

Site: The Main Galleries in the Royal Academy of Arts

Location: United Kingdom

Casambi nodes: 4000



Domus Aurea, Rome

Close to the Colosseum, the Domus Aurea has been called the most extravagant construction in the history of Rome. Following the latest restoration project, a new entrance kiosk and pedestrian walkway by Stefano Boeri Architetti now allows unprecedented access to its subterranean rooms, each illuminated by ERCO with specially tailored solutions.

Casambi was specified because it can incorporate modern lighting requirements, using the pre-existing electrical system, while preserving architectural features and does not require additional wiring for data collection. It provides a flexible solution for setting different scenes on-the-go that can be activated via wireless remote controls and/or presence sensors.

Site: Domus Aurea

Location: Rome, Italy

Casambi nodes: 245



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