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Considering Direct Current (DC) in Smart Lighting Controls

Opportunities & Implications

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Introduction

As the built environment evolves to meet modern demands for sustainability, energy efficiency, and data integration, alternative power distribution models are gaining attention. One such model is the use of low-voltage Direct Current (DC) in smart lighting systems, particularly through technologies like Power over Ethernet (PoE). While Alternating Current (AC) remains the dominant infrastructure and will continue to be essential for many years to come, exploring where DC may offer advantages is a timely and important conversation for the industry.

Prolojik is working with DC systems as part of a broader strategy to support more flexible, efficient, and integrated building environments. This paper outlines some of the industry challenges, the rationale for considering DC-based solutions, and the potential implications for both new and existing projects.

Challenges in Current Lighting Control Infrastructure

Lighting control systems based on traditional AC infrastructure face several limitations that can affect both efficiency and long-term adaptability. One challenge is the inherent energy inefficiency caused by multiple power conversions between AC and DC, which result in unnecessary energy losses. Additionally, AC systems typically require separate wiring for power and control, which adds to installation complexity and limits design flexibility, especially in buildings where space constraints and reconfiguration needs are a concern.

Closed Communication Protocols

Another significant issue relates to the use of proprietary, closed communication protocols. These can hinder the integration of lighting systems with other building technologies and often lead to vendor lock-in, restricting long-term adaptability.

Moreover, many existing systems offer limited real-time operational data, which reduces their ability to support building analytics, automation, or predictive maintenance. Together, these challenges underscore the need for a more open, adaptable, and data-rich approach to lighting control.

DC-Based Smart Lighting: A Potential Alternative

DC-based smart lighting systems, such as those implemented using PoE technology, offer a different approach. These systems deliver both power and control over a single low-voltage cable, typically Cat6, which can simplify infrastructure requirements, reduce cabling costs, and enhance flexibility in design and deployment. In buildings where adaptability and phased upgrades are important, this streamlined architecture may offer considerable benefits.

Prolojik places strong emphasis on the use of open standards and protocols, including DALI, MQTT, and BACnet. This allows for seamless integration with a wide range of building management systems and third-party platforms, helping clients avoid being locked into proprietary ecosystems and enabling greater interoperability as technology evolves.

Another defining feature of the system is its decentralised architecture, with intelligence embedded at the edge of the network. Each control node includes a microprocessor capable of autonomous decision-making, improving system responsiveness and resilience. This decentralised setup also enables edge analytics, reducing reliance on central servers and allowing faster localised data processing.

Data generation and insight are central to the value proposition of DC-based lighting systems.

Real-time Data

These systems collect real-time data on occupancy patterns, lighting usage, and environmental conditions, which can be used to optimise energy consumption, improve space utilisation, and support predictive maintenance strategies. When integrated into wider smart building platforms, such data becomes a valuable resource for facilities management and operational planning.

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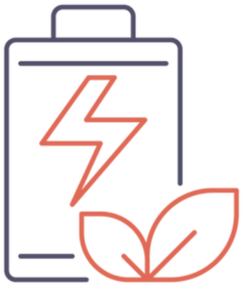
Use Cases & Observed Benefits

The application of DC-based lighting systems has already demonstrated measurable benefits in certain contexts.

Reduction in Cost

In one example, a commercial office development in Central London implemented Prolojik PoE lighting controls solution and achieved a significant reduction in energy consumption, along with a notable simplification of cabling infrastructure and reduction in installation costs.

The integration of occupancy and daylight sensors further enabled dynamic lighting control tailored to real-time conditions, improving occupant comfort and overall system efficiency.



Energy Savings

In the education sector, a leading UK university adopted the same technology for a new STEM facility. The system not only delivered energy savings but also provided facility managers with actionable data on space use and occupancy.

These insights supported more informed decisions about how academic spaces were configured and managed. The solution also included circadian lighting features to support student wellbeing, and its open protocol foundation enabled seamless integration with other building systems such as HVAC and automated blinds.

These examples suggest that while DC-based lighting may not be universally applicable, it can offer considerable value in specific settings, particularly new construction projects or major refurbishments where flexibility, integration, and data insight are priorities.

Environmental & Regulatory Considerations

Standards Compliance

As regulatory and environmental standards tighten, smart lighting systems that operate on DC power are increasingly relevant. By reducing conversion losses and enabling more precise control of lighting and sensor networks, these systems contribute meaningfully to carbon reduction goals.

They also support compliance with a range of certification schemes, including LEED, BREEAM, and the WELL Building Standard.

Beyond compliance, DC-based systems are also capable of contributing to demand-side energy strategies. This includes the ability to respond dynamically to grid conditions, adjust loads in real time, and support broader goals around grid flexibility and decarbonisation. These capabilities position DC lighting systems as a potential asset in the transition toward more sustainable and responsive energy networks.

Conclusion

While AC infrastructure continues to serve as the backbone of electrical systems in most buildings, it is worth considering where DC-based smart lighting could offer practical and strategic advantages. The potential benefits, in terms of energy efficiency, installation simplicity, system adaptability, and real-time data insight, make DC a viable alternative for projects that prioritise performance, integration, and sustainability.

Rather than positioning DC as a disruptive or replacement technology, it may be more constructive to see it as a complementary option. In the right contexts, it can support the evolving needs of modern buildings and provide a platform for more intelligent, responsive, and efficient lighting control.

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