Public Lighting MANAGEMENT

Public lighting is typically responsible for approximately 19% of global electricity use and around 6% of global greenhouse gas emissions and is thus a significant component of electricity utilisation. All forms of public lighting (street lighting, public space lighting, etc.) are fundamental – good street lighting is an essential aspect governing road safety (vehicle and pedestrian) and hence augments a country's transport industry, while well-lit public spaces improve social activity, tourist initiatives and enhance overall security. Both aspects thus contribute toward the general wellbeing of the populace at large and undoubtedly thereby contribute toward an increase in productivity, local economic growth and ultimately could facilitate foreign investment.

It is clear then that, even though public lighting consumes a large portion of utilities' generation capacity, this lighting should not be switched off indiscriminately to accommodate load reduction strategies. However, it is also surely almost sacrilegious to simply waste energy burning lights for no apparent reason other than that these cannot be controlled i.e. remotely switched off, or at least dimmed, when no longer needed. Moreover, it is not only the cost of generation that must be taken into account, but the enormous impact that the production of unnecessary CO_2 gas has upon the environment and consequently the health of those exposed to it, especially children.

INTELLIGENT LIGHTING MANAGEMENT SYSTEMS

The control and management of public lighting is most certainly one facet of the electricity supply industry that, should it be extensively implemented, would contribute toward a more efficient overall consumption of electricity. Fortunately, there are a number of systems available in the market place today that can be cost effectively deployed to successfully manage and control all forms of public lighting. In addition, most control systems can extend to include public irrigation systems. Since all existing network components can be retained, with no additional civil work required, the cost of implementation is surprisingly low.

Any luminary in street lighting installations can be effectively monitored and managed – this includes all LED and high intensity discharge lamps available on the market (HID – mercury vapour lamps, metal halide lamps and sodium lamps), using either magnetic or electronic ballasts. Thus, most solutions, which are readily available in the market place, can be effortlessly embedded and adapted to existing infrastructure of cables, poles, ballasts and light bulbs.

An important consideration for any intelligent lighting management system is the ability to programme the lighting intensity of every single luminaire in the system. This will ensure that light is only provided precisely where and when it is actually needed, and furthermore as efficiently as possible.

The major components of a typical intelligent management system, designed to control public lighting and other auxiliary systems, are shown in Figure 1. Essentially these are comprised of the following components: network management software and server, any IP communications network (Ethernet, GPRS) and a suitable transmission network (PLC or RF). Star and/or mesh network configurations can be deployed as shown.

In reality two distinct options to

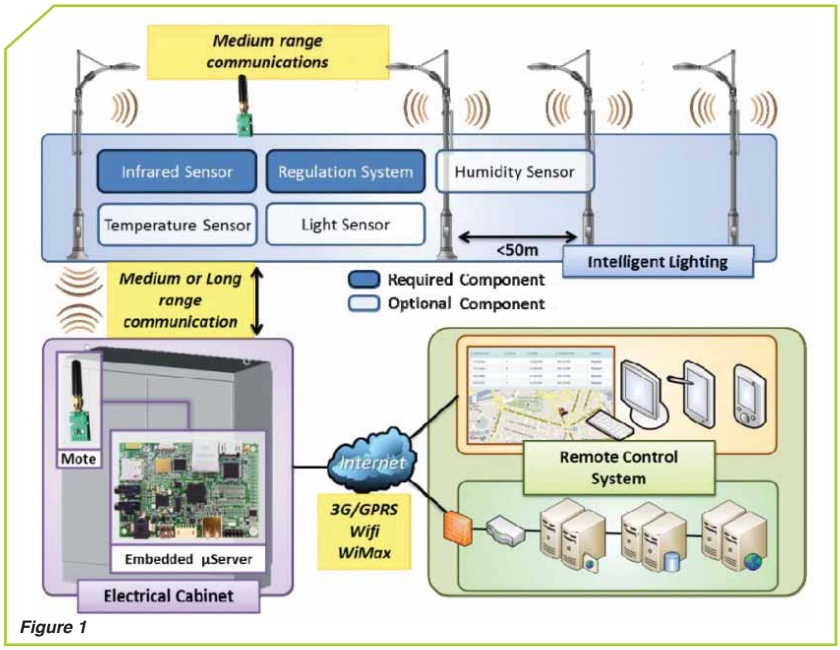

Figure 1

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THE WORLD ELECTRICITY FORUM™

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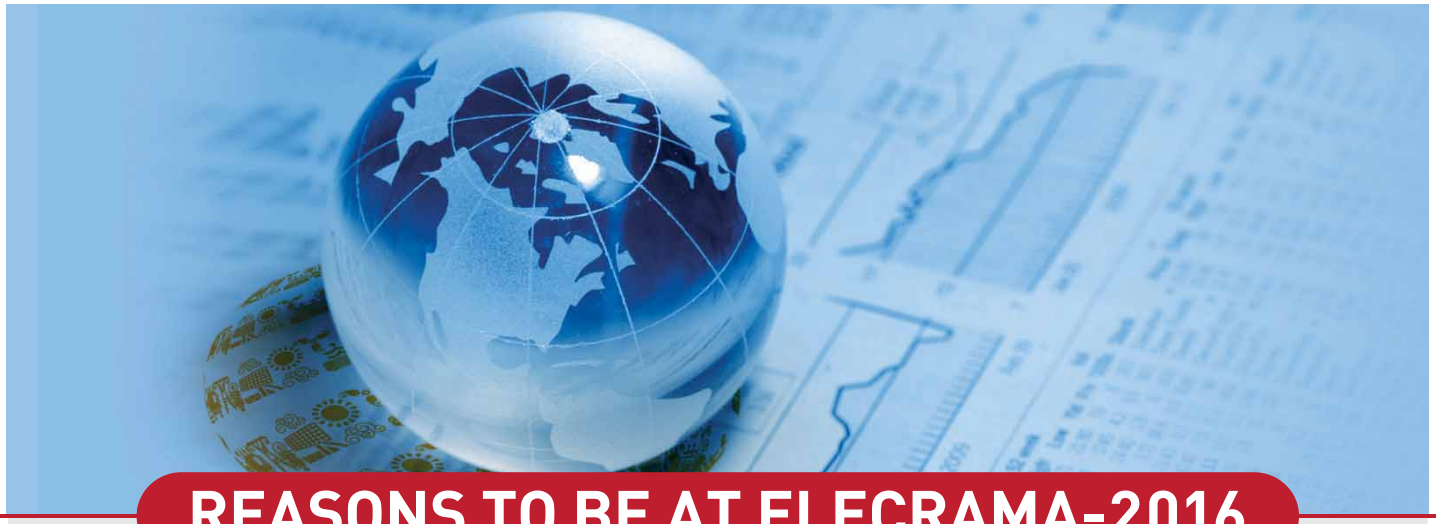

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implement the required transmission network can be considered. These are PLC (Power Line Communications), or Radio Communication systems.

PLC Systems are the natural choice for automating street lighting networks and offer the inherent advantage that these systems utilise existing infrastructure (underground and aerial cables, etc.) that already deliver power. This makes PLC a cost-effective choice. Furthermore, the existing power network of course extends to every unit to be controlled and monitored; hence, little additional infrastructure is required.

PLC also eliminates concerns such as sharing communication frequencies (the operator/utility owns the channel), performance in bad weather and line of sight issues. Network maintenance is further enhanced since communication occurs over maintained lines already delivering power. Moreover, since PLC uses the power line, it can detect when there is a line break together with the approximate location.

Range, speed, and robustness are the critical design considerations with PLC. Power lines carry a tremendous amount of noise, which affects system robustness. G3-PLC communication is a new OFDM-based PLC standard that provides excellent communication over power lines. This standard allows for speeds up to 300kbps, mesh networking capability, and robust mode for high-noise situations. OFDM-based, PLC-controlled lighting networks, similar to G3-PLC, already exist.

Figure 2 shows a typical example of an automated street light network topology using PLC (Reference – 22 March 2013, Maxim Integrated Products, Inc).

Radio Systems for street light management that can be considered include:

1. existing GSM networks,
2. spread spectrum systems, and
3. narrow band VHF/UHF networks.

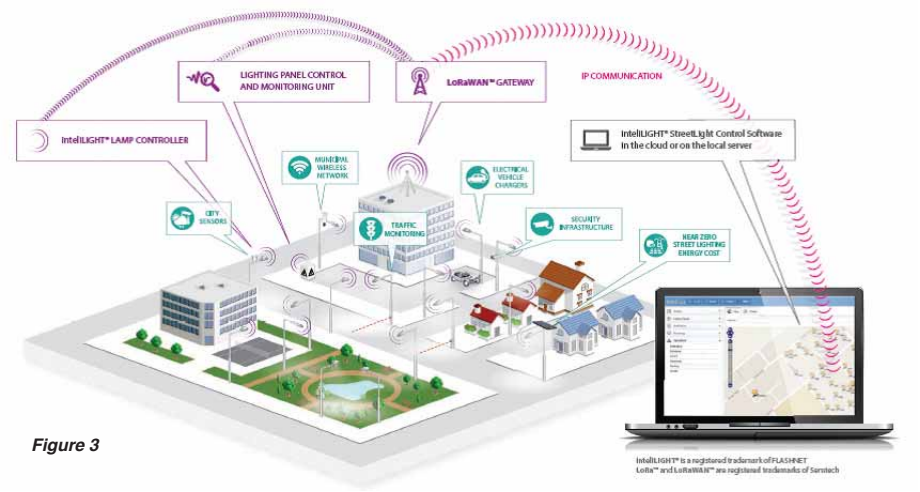


Figure 3

GSM Networks. GPRS and 3G services as provided by cellular operators are normally immediately available in cities worldwide and, since coverage will be adequate throughout the city, this service can immediately be utilised with little or no capital expenditure required. Disadvantages include monthly operational cost and, of course, the utility will have no control over the network and node deployment.

Spread Spectrum Radio Systems typically utilise licence exempt radio spectrum (ISM bands) and are normally fully bi-directional; this allows for full control and monitoring services to be provided. The radio terminal units also generally involve a low supply and installation cost and low power consumption with ranges up to 15km. These aspects, plus inbuilt resilience to interference, make these systems ideally suited to urban deployment. Furthermore, since there is no reliance on commercial radio systems, future availability is guaranteed and connection can be provided to all individual units. By way of example, the inteliLIGHT radio communication system is shown in Figure 3.

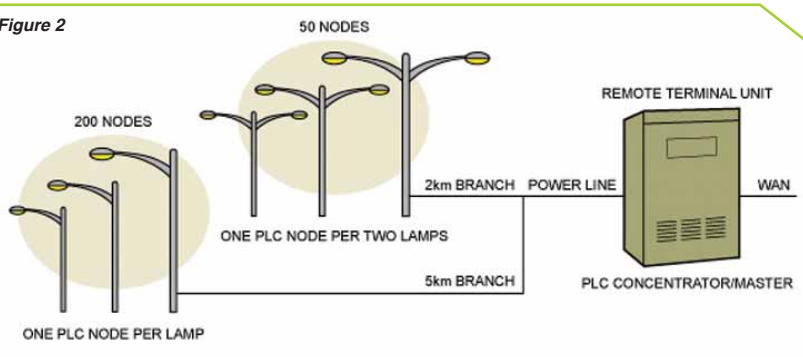
Narrow Band VHF and UHF. Most utilities already operate extensive narrow band VHF and UHF networks. These can also quite readily be adapted to provide communication links for light management systems. However, the longer ranges associated with these frequencies would make these systems more suited to suburban and rural deployments.

Sensors. Managed street light networks, due to light level control, are continuously under power; hence, a large assortment of sensors and applications can be installed on the lighting network. These include security cameras, communication antennas, pollution sensors, noise detectors or traffic density sensors.

Controllers are normally mounted inside or outside the street lighting fixtures, while the communication devices are placed inside the power supply cabinets. PLC or RF communication can be used between the lamps and the power supply cabinets. Signal repeating mechanisms make it possible to communicate securely even over the largest street lighting networks.

Maintenance. Another distinct advantage associated with remote management systems is the facilitation of general network maintenance through the ability to monitor the network. The status (brightness, temperature, voltage, current, power and power factor information) of all luminaries controlled is displayed. Hence, outage times are significantly reduced as maintenance teams can immediately be dispatched to repair faulty units and are not dependent upon these being reported by members of the public. Furthermore, responses to events and alarms can be effectively monitored.

Figure 2



LED LIGHTING

In addition to intelligent management systems, the introduction of energy efficient LED street and public lighting will also significantly contribute toward a reduction in load demand – from 50% to

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LED LIGHTING SOLUTIONS

Lighting contributes to about 25% of the average home's electricity costs. For commercial buildings this number approaches 50%. In today's climate of soaring electricity costs finding energy efficient alternatives is no longer solely about adopting environmentally friendly energy solutions, rather, there is a very real financial benefit to doing so.

Light-emitting Diodes or "LEDs" are a semi-conductor light source which rely on electroluminescence (the use of electric current to generate light.) This differs from traditional solutions like incandescent bulbs, which use heat, and Compact Fluorescent Bulbs (CFLs), which use chemical reactions.

Helping businesses to convert to modern and efficient lighting that saves energy

Did you know that modern LED lighting gives you the following advantages?

- Uses only 30% or less electricity than conventional lighting
- Has payback periods of less than 12 – 24 months
- Is much more eye-friendly than conventional lighting
- Has a positive effect on the brain that improves productivity

ALTSA is a supplier of modern (SABS approved) lighting products that are guaranteed to last more than 5 years.

ALTSA delivers lighting projects to convert your current lighting to long-lasting efficient solution.

Our Products

ALTSA has over 4 000 models for various environments, luminance, beam angles, and colour temperatures guaranteed to satisfy any requirement. All products have SABS, UL, ETL, TUV, CE and FCC certification.

In tough economic times ALTSA provides lighting at rental terms with rental amounts that is far less than your savings, positively improving your cash-flow significantly.

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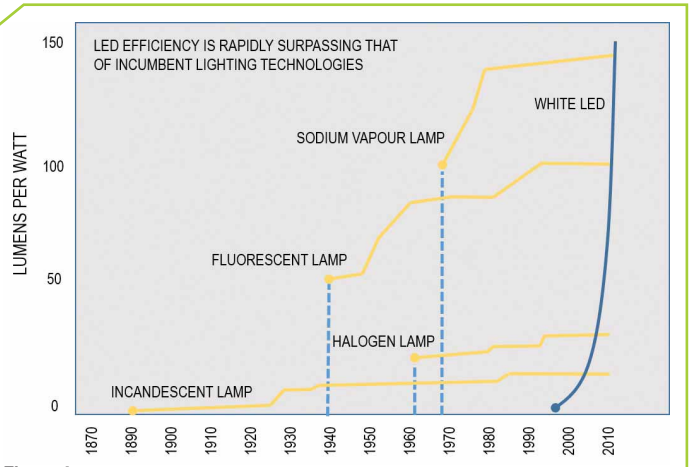

Figure 4

70% when compared with conventional technologies – and also result in similar reductions of carbon emissions.

Superior control over light colour, intensity and direction allows novel lighting system designs that can deliver a wide range of social co-benefits. Improved colour recognition, through the use of white light produced by outdoor LEDs, offers improved visibility for pedestrians and traffic, creates a more secure environment and reduces light pollution (LEDs provide highly directional light).

The major barrier preventing the roll out of LED technology remains the high upfront costs involved. However, this continues to reduce as the technology matures and, while the cost of LEDs has decreased substantially over the past decade, light output and efficiency have steadily increased (see Figure 4 above). Prices are expected to continue their decline over the next five years as demand and production ramp up and innovations migrate from laboratories to production lines. Table I shows expected improvement in efficacy and pricing of LED devices.

Although initial installation costs may be high, low maintenance costs and longer lifespans of LED products should be taken into account when new installations are considered. LEDs are extremely durable, and are resistant to vibration and other mechanical stress, which makes the product ideally suited to lighting applications on bridges and elevated highways and can also help to alleviate problems as a result of vandalism.

LEDs also typically have longer lifespans since the materials used in construction are inherently stable. Experience has shown that LEDs can last up to 100,000 hours and beyond; this is around five times longer than the most advanced fluorescent lights. Consequently, overall maintenance costs related to lamp replacement will be reduced accordingly. Typical life cycle costs, across luminaire technologies, are shown in Figure 5.

Furthermore, LED technology is more suited to smart controls as, unlike conventional technologies which tend to suffer a decay in quality (lumen depreciation) over time and have shorter lifespans when dimmed, the lifespan of an LED increases when average current flow is reduced.

CONCLUSION

The combination of an intelligent lighting management system, controlled centrally, together with efficient LED lighting will result in significant energy savings and in addition will guarantee that generation provided for public lighting is most effectively utilised and not wasted by the superfluous operation of public lighting (including daylight burners).

A further consideration would be the inclusion of solar street lighting into the mix wherever feasible – these of course have a zero impact upon energy supply and at times can also feed surplus energy back into the grid. Clearly then, an arrangement integrating a management system with a mixture of LED and solar lighting will provide the ultimate solution.

Lamp Type	2010	2012	2015	2020
LED Cool White Efficacy (LM/Watt)	134	178	224	258
LED Cool White Price (US$/KLM)	$13	$8	$2	$1
LED Warm White Efficacy (LM/Watt)	96	141	202	253
LED Warm White Price (US$/KLM)	$18	$7.5	$2.2	$1

US DOE, 2011, SSL RESEARCH AND DEVELOPMENT: MULTI YEAR PROGRAMME PLAN.

Table 1

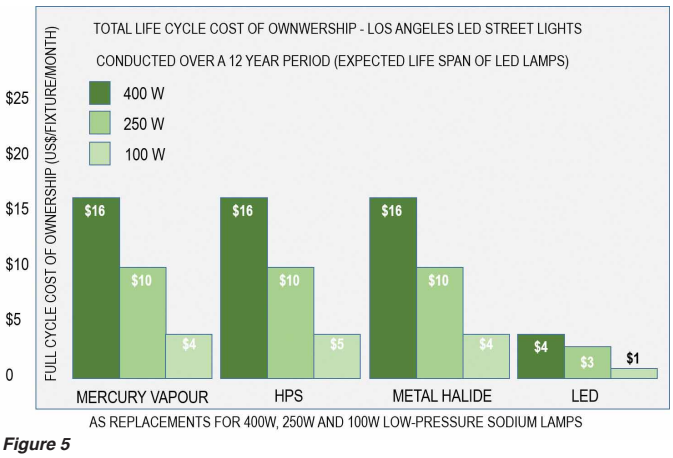

Figure 5

A well designed and operated lighting management system, retrofitted to an existing public lighting network, can bring about energy savings in the order of 35% and operational cost savings up to 40%. The introduction of LED lighting alone can result in an energy saving of 50 to 70%; however, when these are deployed in conjunction with smart controls which allow lighting levels to dynamically change in response to local conditions, total system energy savings can reach up to 80%.

And finally, environmental benefits cannot be ignored. The reduction of energy waste will almost invariably significantly reduce the CO_2 footprint of a city and consequently ensure a healthier environment for all residents. ESI

Reference:
Lighting the Clean Revolution June 2012

Article supplied by the Africa Utilities Technology Council (AUTC)

website www.autc.biz