WHITE PAPER

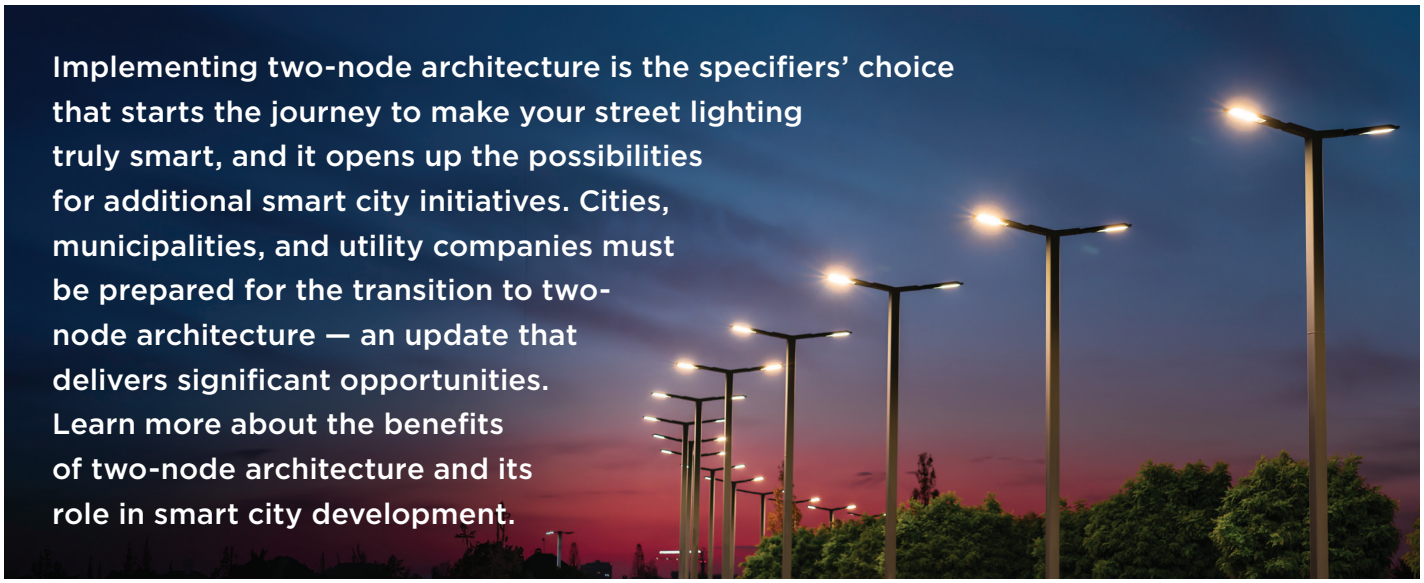
TRANSFORMING STREET LIGHTING

The Power of Two-Node Architecture for Smart Cities

INDUSTRIAL

As cities around the globe strive to become more efficient and sustainable through the use of technology and digitally connected devices, smart streetlights are emerging as a key entry point for smart city applications. Advanced street lighting systems can do more than simply illuminate the area below — they can serve as the infrastructure's backbone that unlocks smart city capabilities.

These modern lighting systems have great potential for standardization and the possibility to integrate sensors, communication networks, video capabilities, and other functions. With these capabilities, cities, municipalities, and utilities can improve efficiency, expand public services, and uncover potential new revenue streams.



TWO-NODE ARCHITECTURE VS. SINGLE-NODE ARCHITECTURE

Street lighting has traditionally used single-node architecture — a platform extensively used in many cities today. In this design, each streetlight needs to be operated independently and is equipped with its own control and monitoring mechanisms. Several ANSI standards are used for single-node lighting systems.

In many parts of the world, power is permanently connected to the streetlight and there must be a control device on the luminaire to sense daylight and turn the light on and off as needed. The **ANSI C136.10 Standard** provides a common platform for interchanging photocontrols and receptacles for these systems. In North America, ANSI C136.10 became the standard interface for roadway and area lighting, and it became the de facto standard in much of the world, despite its shortcomings.

As energy costs have risen and LED technology has become more prevalent, **ANSI C136.41** was developed to define devices and receptacles for increasing the efficiency of roadway luminaires. Created to be backward compatible with existing lighting systems, this standard maintains the 3-pole line voltage connection and adds contacts for signal output, allowing for either digital or analog dimming control by a photocell.

While single-node architecture focuses on simple functionality (switching the streetlight on and off), two-node architecture is a newer standard that is growing in use as more cities and municipalities move toward smart lighting and smart cities. Two-node architecture incorporates an upward-facing node, to house a photocell or communication node, and a second node for motion or other sensor types for which a downward viewing angle is appropriate. This interface uses digital communication that can be utilized by control devices and sensors — making street lighting systems a building block of smart city applications.

ZHAGA PLATFORM FOR TWO-NODE ARCHITECTURE

Zhaga is the leading platform for two-node architecture. A global lighting industry consortium, Zhaga was formed in 2010 to standardize LED component interfaces in luminaires. In an effort to expand the interoperability and functionality of components, they worked with the DALI Alliance to develop the **D4i protocol** and create the Zhaga-D4i certification program, the first certification program for streetlights and control devices. The **Zhaga Book 18 Standard** was designed specifically for LED lighting and differs from ANSI C136.41 in that the power supply unit (PSU) is incorporated into the luminaire instead of the photocontrol, either as part of the LED driver or separately. This reduces the complexity of control devices, removing cost and reducing their size. The digital protocol simplifies wiring in the luminaire and facilitates the two-node architecture.

Globally, most cities and municipalities have used luminaries designed to operate using ANSI C136 standards. Typically, it is a matter of simply replacing the luminaire head to install a new one that is compatible with Zhaga Book 18 standards and functionality. A range of smart city devices can then be plugged into that upgraded luminaire at different times. This increases its useful life, as the control device can be upgraded but the luminaire does not need to be.

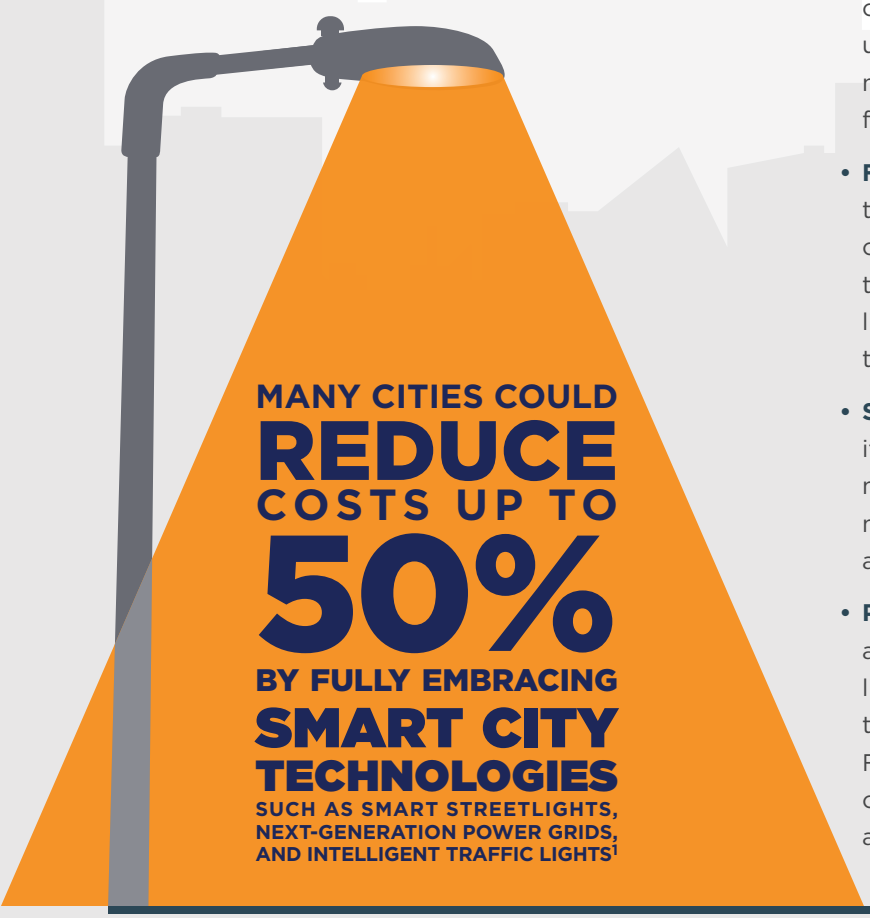
With a new generation of digital drivers, Zhaga expands the capabilities of outdoor LED lighting fixtures to act as a platform for sensors as well as communication devices — making this infrastructure the most cost-effective method for city-wide deployment of sensors and controls. With all the advantages of a regular positioned power supply and vantage point, cities will be able to use lighting systems as the basis for such features as sensors for vehicle or pedestrian counting, traffic reporting, pollution detection, and other purposes.

WHAT ARE THE BENEFITS OF TWO-NODE ARCHITECTURE?

The concept of smart cities has been discussed for many years, and technology advancements are beginning to bring the idea closer to reality. The Zhaga-D4i ecosystem is the backbone of this movement, as it is a cost-effective way for widespread development and deployment of smart city sensors and technologies, eliminating the need for one organization to provide the end to end solution. Different parties can provide products matching their expertise; luminaire manufacturers can provide luminaires, photocell manufacturers photocells, and sensor manufacturers sensor nodes.

Modernizing street lighting architecture with two-node luminaries and smart controllers can deliver significant benefits for cities, municipalities, and utility companies, including:

- **Operational savings and cost efficiencies:** Systems with smart capabilities can automatically dim lights when there is no motion detected, adjust light levels based on traffic volume, or monitor maintenance issues. This can improve system energy efficiency and streamline operations and maintenance, saving money.



- **Adding smart functions:** Communication and analytics from smart street lighting are the foundation for such functions as smart sensing; pollution, air quality and traffic monitoring; public Wi-Fi; parking control; and other possibilities.
- **Interoperability:** Zhaga standards ensure standardized interfaces that support interoperable components, which allows LED luminaires to be upgraded and serviced. This standardization also makes it easier for OEMs to deliver best-in-class final products.
- **Future state:** Deploying two-node luminaries means that as more devices are developed and released, cities can plug them into these lighting systems to increase functionality throughout their product lifetime. The technology is still developing, and two-node architecture opens future possibilities.
- **Standardization:** Standardizing the luminaire, with its defined wiring structure, power budget, common mechanical interface, and communication protocol, means all luminaires across the whole network operate and can be maintained in the same way.
- **Potential new revenue streams:** Two-node architecture makes street lights more than just a lighting source, allowing cities and utilities to monetize that asset so it becomes an additional revenue source. For example, they could lease a connection to cell companies or make traffic movement information available to public transport providers.

INDUSTRY LEADERSHIP AND EXPERTISE IN TWO-NODE ARCHITECTURE

As an industry leader in the development of two-node architecture, TE Connectivity (TE) provides innovative, complete solutions for smart street lighting systems. TE experts were involved in the creation of Zhaga standards and two-node architecture protocols, and TE offers a complete lineup of solutions that meet Zhaga, ANSI, and hybrid standards for the global market. These solutions include:

LUMAWISE ENDURANCE S2 CONNECTORS

Designed specifically for the two-node architecture with their two wire poke-in per contact and industry-standard mating interface.

LUMAWISE ENDURANCE N POKE-IN

The next generation of ANSI-type streetlight dimming receptacle, designed to reduce OEM's manufacturing inefficiencies and narrow supply chain.

LUMAWISE ALR 11000 ZHAGA DIGITAL PHOTOCELL

Adds diming and digital control in a Zhaga reduced size form factor.

LUMAWISE MOTION SENSOR PROGRAMMABLE

Enables energy savings by dimming the luminaire while still being able to react to motion and bringing the luminaire to full brightness for safety and security. Versions are available that fit the Zhaga-D4i or 0-10 V ecosystems.

With extensive market knowledge and expertise about the mechanics of the ecosystem's interoperability, TE can help you select devices and solutions that work with your customers' nodes and cloud platforms to deliver optimum results.

By upgrading to smart street lights, cities can unlock a wide range of capabilities that enhance energy efficiency, improve public safety, and lay the groundwork for a more connected, efficient, and powerful smart city network now and into the future.

Connect With Us

We make it easy to connect with our experts and are ready to provide all the support you need.
Visit **te.com/support** to chat with a Product Information Specialist.

[1]ABI Research: Smart Cities and Cost Savings

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