

Light Energy Harvester Powered Wirepas Mesh Network Anchors

Introduction

The Internet of Things (IoT) continues to evolve and as systems grow in scale new challenges become apparent. For example, how do you efficiently increase the scale and coverage of IoT networks whilst maintaining functionality, how do you replace battery powered devices when the batteries have lost charge? Such challenges are becoming apparent as IoT systems mature. There are many computer communication networks and protocols, including cellular (3G, 4G and 5G), BLE, WiFi etc. each having their own pros and cons. The one thing they have in common is they are centrally controlled and any increase to the size and scale of the network requires human intervention. In contrast, the Wirepas Mesh network is a decentralized wireless communication protocol designed for large-scale IoT applications. Where traditional networks rely on a centralized infrastructure such as routers and gateways, Wirepas enables every device in the network to act as a router, allowing a decentralised scalable, self-organising, low power network.

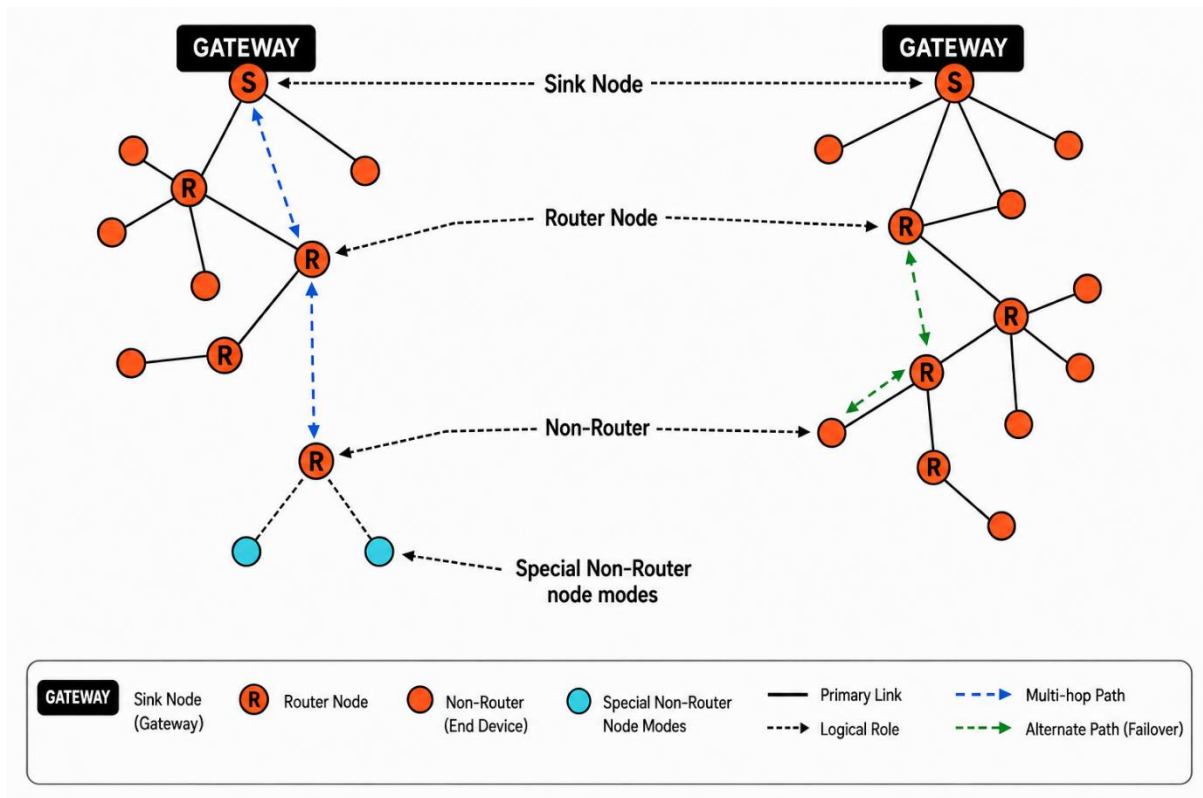
As a Wirepas Mesh network is low power it means for some key components of the network we can alleviate the use of batteries. Lightricity has developed 'Anchors' powered by indoor light. The energy harvester powered anchors offer a reliable, sustainable solution removing the need, and cost, of replacing batteries as explained below.

Components of a Mesh Network:

The Wirepas Mesh Stack has 3 main device types in addition to the gateway and a 4th component in very dense networks as described below.

1. **Anchor or Router Node:** This type of node acts as a central hub through which data can be transmitted in an ad hoc manner; it can be considered as a low power pseudo-gateway. A key function is to optimise the network routes by calculating the best path to the gateway.
2. **Endnode or Non-Router Node:** Usually a simple sensor node that only sends messages and its own data to an anchor, it is not involved in any optimisation, forwarding or forming clusters of nodes.

3. **Sink Node:** The Sink Node connects to the gateway, capturing messages from all of the nodes in the network and transmitting it to the gateway serially and the gateway then forwards it to a backend cloud, thereby allowing the messages to be viewed on a dashboard.



Schematic of a Wirepas Mesh Network

The benefits of a Mesh Network:

There are many advantages of a Mesh Network as outlined:

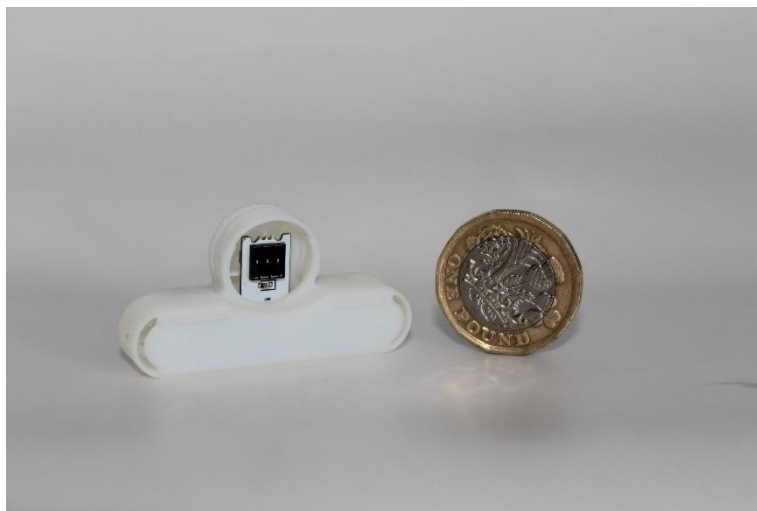
- ✓ **Decentralized Intelligence:** Each device contains the full protocol stack and can independently manage routing, joining, and optimization.
- ✓ **Hardware Independence:** Devices operating on the Mesh Stack are able to interact and form a network with other devices irrespective of the radio chipsets they are using, offering flexibility across applications.
- ✓ **Self-Healing & Self-Optimizing:** The network automatically adapts to changes, interference, and device failures without manual intervention.

- ✓ **Massive Scalability:** Proven to support networks with hundreds of thousands of devices—for example smart meters.
- ✓ **Low Power Consumption:** Even routing devices can be battery-operated with multi-year lifespans.
- ✓ **No Additional Infrastructure Needed:** Devices form the network themselves, eliminating the need for external communication infrastructure.

As mentioned above one of the benefits of a mesh network is that many of the devices are low power and this enables some of the key components of the system to be powered by batteries. However, batteries are not the panacea as they exhibit a number of downsides; for example, when the batteries have reached their end of life the device will cease to operate, the requirement to change batteries in large networks can be costly in terms of both time and money. <https://lightricity.co.uk/true-cost-of-batteries>

Anchor nodes are currently powered by batteries, and this means they have a relatively large form factor and there is always the possibility they will cease to function when they run out of battery power. Luckily, there is now a sustainable, affordable and reliable alternative to the use of batteries.

*Lightricity **4EverMesh** Anchor*



Lightricity has developed an anchor powered solely by indoor light. The device includes a world leading light energy harvesting cell and a hybrid storage element, thus ensuring full functionality even when no light is available.

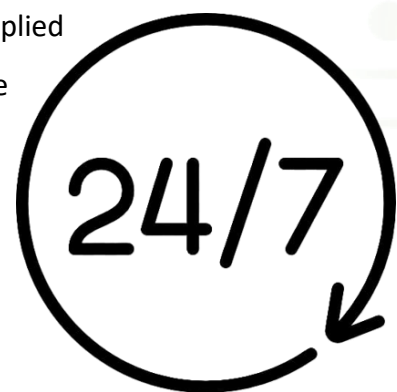
The **4EverMesh** has a small form factor, is unobtrusive, light-weight and therefore easy to instal or retrofitted with no specialist knowledge required. In addition, the 4EverMesh can be integrated into existing networks and will operate seamlessly alongside battery powered anchors.



How does it work when there is no light? Well, the device has a hybrid storage element that is charged during the time when light is available and the stored energy discharged to enable operation during periods of darkness. Two operating modes have been engineered into the device.

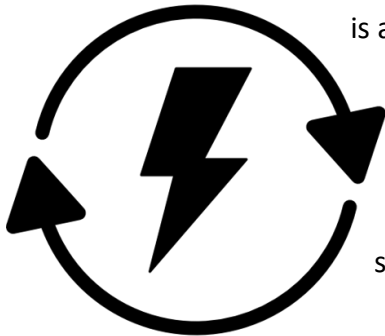
24/7 Mode:

In the 24/7 mode the mesh stack is always operating and is applied when the network must function continually for example when asset tracking in a warehouse. In this mode it guarantees a stable and optimized network when operating under constant light. This provides a runtime without light of 3-4.5 days.



Energy Saving Mode:

The Mesh stack only runs when there is light level greater than 5000 lux. For an anchor that is already on, the device is put to sleep 5 minutes after the light is switched off. The energy saving mode is applicable in use cases where there is no need for the network to be operational in times without light (e.g. Asset tracking in a secure office or hospital).



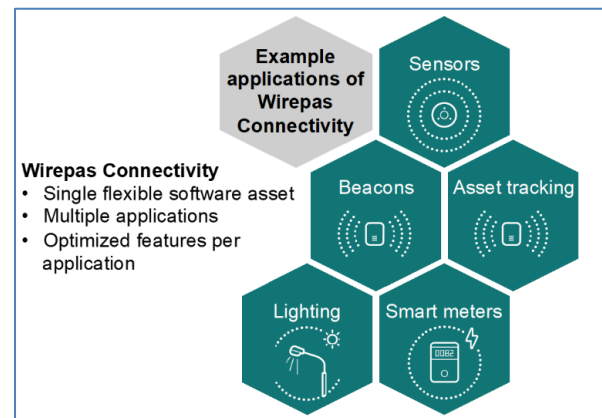
There is a limitation to the energy saving mode, that being, the stability of the network may not be guaranteed as the stack is only on for as long as the light is on. Without light, the system enters a sleep mode and will remain dormant for up to 3 months, and will reboot immediately light is present.

Application of Mesh Networks:

Wirepas Mesh networks are ideal for:

- Smart metering
- Asset tracking
- Industrial IoT
- Smart lighting
- Building automation

The benefits are its ability to cover large areas, penetrate deep indoor environments, and maintain high reliability making it ideal for real-world deployments.



In Summary

The growth in IoT networks is delivering many benefits to businesses and consumers. However, as the network scales new challenges emerge for example reconfiguring the system as it expands, low energy electronic has enabled the introduction of battery powered components. However, when there are 1,000's of battery powered components in a network changing the batteries when they run out of power is challenging and also not an

environmentally friendly solution.

The Wirepas Mesh network addresses the challenge of scalability and the introduction of the **4EverMesh** light powered anchor alleviates the need for batteries enhancing reliability, sustainability and reducing lifetime costs.

Lightricity PV technology

Our technology is the world's most efficient indoor PV technology (though it works outdoors too). It converts indoor light sources to energy with up to 35% efficiency – a more than six-fold improvement on conventional PV, as validated by the UK's National Physical Laboratory (NPL).

A panel the size of your fingertip will power your IoT device forever. Even in extremely low indoor light. Our technology can be sealed in the device and the cells themselves will operate at temperatures from -40 to > +100 degrees, opening possibilities to power devices not previously thought possible with indoor IoT. The cells can withstand wave flow soldering conditions.

We offer two solutions. For those designing new connected devices, our customisable PV panels can be integrated into any low-power IoT device as an alternative to batteries. For Mesh Networks we offer off-the-shelf, easy-to-integrate, PV-powered Anchor Nodes.