ubicquia

Connecting the Future

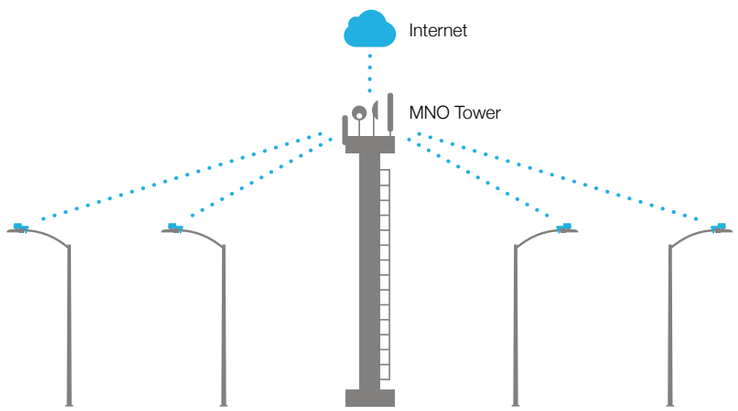
LTE Cellular Network Versus RF Mesh Network Analysis

Connectivity provides the essential foundation and digital infrastructure for today's modern city. Critical physical infrastructure, such as roads, streetlights, and the power grid, all rely on smart, Internet of Things (IoT) technologies to operate properly and deliver their maximum value. Without secure, reliable, and robust connectivity, the value of smart technologies and the promise of a smart city are impossible to achieve.

When communities are choosing connectivity platforms, there are several options to consider with many complex yet important considerations. Affordability and the real cost (including the risks) of ownership related to operating a specific technology architecture must be factored into the decision making process. For most cities, this connectivity choice will be one of the most consequential decisions that a city official will make, as it has a significant financial, social and economic development impact implications for generations to come.

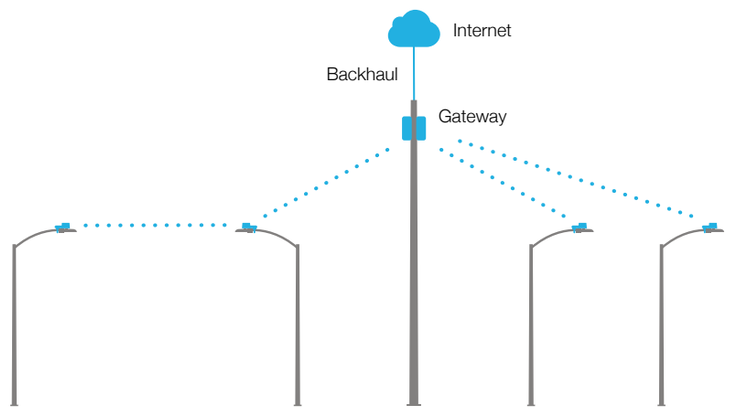
Two of the most popular and effective communications architectures to support smart city applications (example – smart lighting) are LTE cellular and RF mesh. Each architecture has its own unique characteristics, and it is extremely important to understand the risks and benefits associated with each. We'll compare the two networks in the areas of security, reliability, affordability, scalability and ease of operations.

Network Comparison



LTE Cellular Network

In an LTE cellular network, a smart lighting system connects directly to a mobile network operator's (MNO) public cellular network (licensed spectrum) for two-way data communications. The central management system (CMS) is in the cloud. This allows a city to remotely monitor and manage their smart streetlights, create dimming schedules and track operational data such as energy usage and lamp burn hours. Most of the communications platform hardware, software updates, outage management and other functions are managed by the MNO. The city only has to install a "node" to be able to create the communications network.



RF Mesh Network

In an RF mesh network, an operator must deploy similar nodes as the LTE Cellular network, but also must install gateways. Each gateway provides the connection back to the private network using unlicensed frequency spectrum. In this example, a certain number of streetlights (that are in close proximity to a specific gateway) are connected directly to that gateway. When a node is out of any gateway range, it will connect to another node to establish its connectivity to the network. This private network is owned and operated by the city instead of an MNO. The city must install and manage all the nodes, gateways, software and more.

Security

Network Comparison

When operating a digital communications infrastructure, if you don't have a trusted and secure platform to handle your most sensitive and important data, then you have failed the most critical, foundational requirement. Communications networks handle enormous amounts of data and increasingly, IoT technologies analyze, operate and monitor a city's most vital infrastructure.

Network Type	Considerations	Score
LTE cellular	Uses licensed frequencies employed by large, well established, trusted mobile network operators. The MNOs pay for the licensed spectrum, the technology is standardized and proven, and the networks are managed and maintained by the MNOs themselves. This provides a very high level of security that must be maintained by the MNOs to exacting industry standards at all times, including security requirements. Each node connects directly with the cloud with no direct connection to a gateway that can breached.	★★★★★
RF mesh	Uses unlicensed communications frequencies. This means that a city can create its own private network wherever it wants to, as long as the network complies with existing standards and the communications frequencies are approved in the country of use. The cost and burden of managing network security falls on the city. It can be expensive, reliant on skilled labor and requires a level of vigilance and dedication to be prepared at all times to deal with security threats. Additionally, each gateway represents an "attack surface" that can be breached by hackers, in which malware can be introduced into a network attached to critical infrastructure assets.	★★★

Reliability

Network Comparison

Both LTE cellular and RF mesh networks are reliable in terms of system uptime, but the potential impact of outages, maintenance requirements and reliance on skilled labor are not insignificant. These factors must also be considered as they ultimately affect uptime.

Network Type	Considerations	Score
LTE cellular	Mobile network operators maintain the network and are ready to rapidly resolve any issues to make sure their business model provides the most reliable network in exchange for the fees associated with the using the platform. Additionally, if a node fails, it only affects the single connection point and can be quickly identified for replacement. Since the node connects directly with the cellular network, there is never a single point of failure for the network itself.	★★★★★
RF mesh	The city operates its own network and must rely on highly trained, skilled labor and availability of critical hardware to maintain the networks operational status. Today's RF mesh network is "self-healing", which means active nodes in a mesh can compensate when a single node fails. This helps to ensure system uptime but a city's technical staff must intervene in the case of a gateway failure or other system-wide issue.	★★★

Affordability

Network Comparison

LTE cellular and RF mesh networks have both similar and also different costs associated with the deployment and operations of a network.

Network Type	Considerations	Score
LTE cellular	The costs to build this network are lower with less hardware to purchase and little network planning (engineering) required. The one drawback of LTE cellular is the ongoing data fees that the MNOs charge. Some of these costs are coming down, due to computing (or “edge processing”) that requires less transmission of data relative to the increased capabilities the IoT devices possess. But many of the data fee costs are offset by the lack of skilled personnel cost and the ability to have a low cost deployment. Typically, LTE cellular networks require 10% less maintenance trips than its RF mesh counterpart.	★★★★
RF mesh	The operating costs for an RF mesh network is much lower than a cellular network because a city is not paying data charges to a third party service provider. With that said, the additional hardware costs, the network planning cost and the ongoing cost of highly trained, skilled labor can often more than offset the cost benefit achieved by using unlicensed spectrum as part of a privately operated network. Additionally, since the network is less reliable and there can be a lack of trained personnel to perform routine network maintenance, the total cost of ownership further increases as downtime can be very costly for critical infrastructure. Typically, RF mesh networks require 10% more maintenance trips than its LTE cellular counterpart, in addition to requiring more time to troubleshoot the source of a problem when it occurs.	★★★

Scalability and Ease of Operations

Network Comparison

Each network must have low latency, be able to scale and be ready to embrace the latest technologies to unlock the full value of smart technology and infrastructure innovation.

Network Type	Considerations	Score
LTE cellular	MNOs invest heavily to keep their networks operating at peak efficiency. The architecture of an LTE cellular network enables the lowest latency communications. This allows both information to be transmitted to key decision makers in the shortest amount of time possible and also corresponding actions to be taken as quickly as possible. When a public network managed by the MNO needs to scale, it can be done quickly, with little cost and have fewer potential limitations given its architectural requirements that are being professionally maintained for the city. Additionally, LTE cellular nodes have a single IP, allowing for easy troubleshooting, firmware updates to be regularly pushed out by the carrier and are much easier to support overall.	★★★★★
RF mesh	Private network operators must make their own ongoing investment to modernize their platform to be ready to embrace the latest technology applications. The network has slightly more latency, given its architecture. Once data is received, it may take a bit more time for user inputs to take effect throughout the network and the infrastructure that it is attached to. When a private network needs to scale, it will require more network planning time, cost, and have potentially greater limitations given its architectural requirements. Firmware updates tend to be less reliable due to the complexity of the mesh or they can be difficult to deploy. Additionally, RF mesh networks troubleshooting is more complex, and an operator must first determine if the failure is the node or the gateway.	★★

Conclusion

LTE Cellular Networks Offer Clear Advantages

Smart city infrastructure requires connectivity to operate properly and deliver its maximum value. Without secure, reliable, and robust networks, the promise of a smart city are impossible to achieve. That's why the network you select is critical. It's clear that LTE cellular networks have several advantages over RF mesh networks. Especially if you analyze the differences in several key areas from reliability to security and affordability to ease of use. For most cities, this connectivity choice will be one of the most consequential decisions to make, as it has implications for years to come.

Attribute	LTE cellular	RF mesh
Security	★★★★★	★★★
Reliability	★★★★★	★★★
Affordability	★★★★	★★★
Scalability and Ease of Operations	★★★★★	★★

Ubicquia® started with a simple idea: we can use existing streetlights and utility poles to make communities smarter, safer and more connected. Since then, the company has helped municipalities, utilities and communication service providers control lighting costs; accelerate 5G deployments; extend public WiFi; deliver video security services; and protect against grid failures. Ubicquia's products are compatible with more than 360 million streetlights and 500 million utility poles worldwide. We are dedicated to making technology that is simple to deploy and monitor.