LigoWave

Wireless Video Surveillance in Practice

White Paper, 2018

Keeping an Eye on Things

Wireless Video Surveillance in Practice

The purpose of this whitepaper is to provide a clear understanding of how modern video surveillance networks function using LigoWave's DLB series of wireless data transfer equipment. This is achieved through a discussion of the processes, technologies, and theory involved in video surveillance as well as through presentation of LigoWave success stories pertaining to video surveillance scenarios.

Introduction

The idea of surveillance has taken on many different forms throughout human history, but there is one thing about it that has never really changed: the fact that it is an invariable necessity.

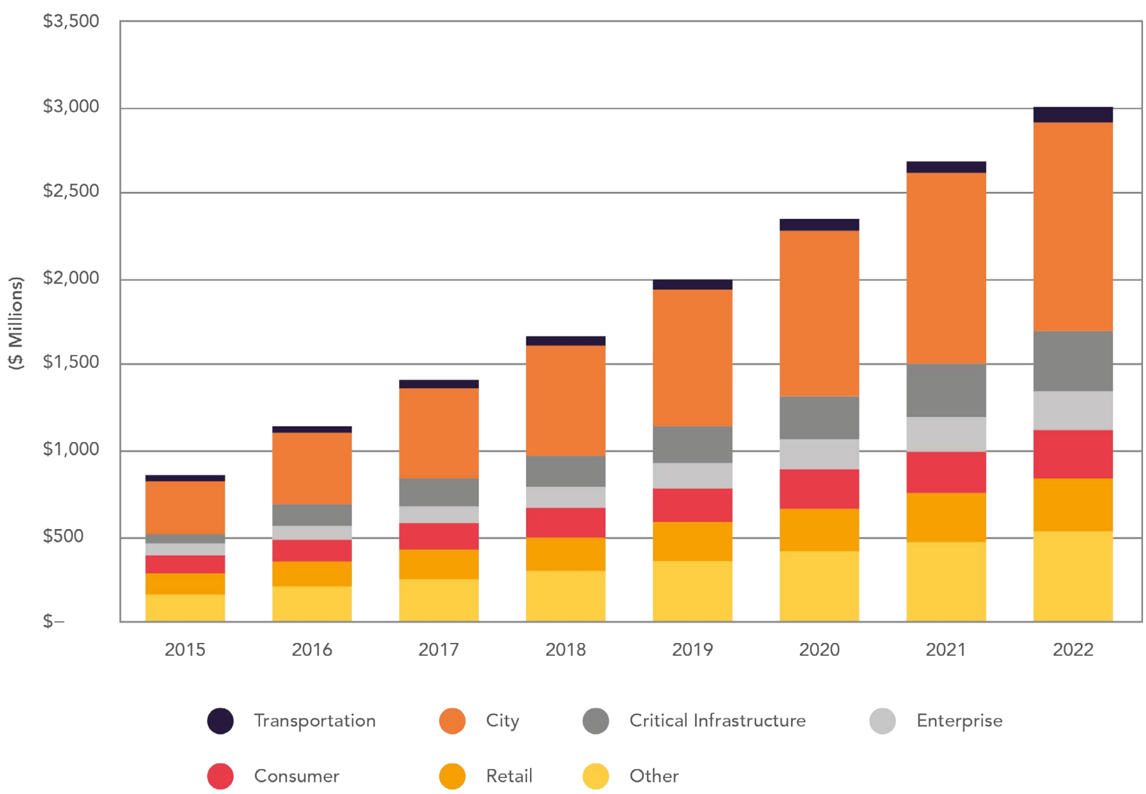
Surveillance camera use has been increasing over the last decade[1]. Besides the equipment becoming progressively inexpensive and the ideal alternative to hiring night guards, modern IP surveillance cameras are now sufficiently capable of recognising people, objects, patterns, and symbols, thus broadening their scope of use beyond bare surveillance.

Video analytics systems are drawing increasing attention in retail, transport, consumer, urban, critical infrastructure, and enterprise markets. The most significant growth is expected in retail and transport, where applications, such as traffic light monitoring, highway safety, trafic management, and video surveillance, have become inevitable[2].

Moreover, the addition of deep learning algorithms pushes equipment efficiency and productivity forward with each minute.

It is estimataded that the total revenue of the video analytics industry alone will reach $3billion by 2022 with the forecasted revenue of the total video surveillance market becoming $62.62 billion by 2023[3].

Video Analytics Total Revenue by Application market, World Markets: 2015-2022



Graphic Source: Tractica[2]

[1]Video Surveillance Trends for 2018—IHS Markit. Retrieved from here.

[2]Video Analytics Hardware, Software, and Services Revenue to Reach $3 Billion by 2022—Tractica. Retrieved from here.

[3]Global Video Surveillance Market Analysis and Forecast (2017-2023)—Report Buyer. Retrieved from here.

How Does It Work?

A handful of equipment goes into setting up a wireless video surveillance network. These include:

- IP surveillance cameras for capturing video footage;
- wireless data transfer devices, such as base stations and customer premises equipment (CPE), for delivering video from the site to the surveillance room;
- monitors and computers for video playback, processing, and storage;
- possible wiring, mounting components, and other accessories typically included with the required equipment.

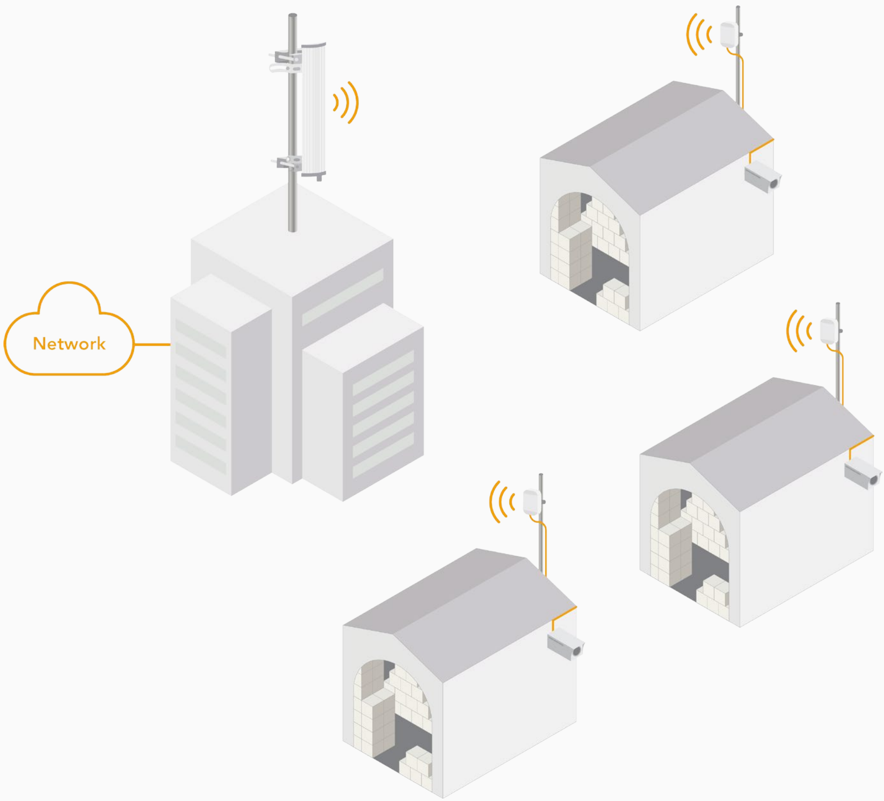
Some surveillance networks may also include other equipment, such as digital video recording units, external storage devices, and servers.

Surveillance Scenario

Using LigoWave wireless devices, a network of IP surveillance cameras would fundamentally look like this:
As an additional security and disaster prevention measure, an industrial business decides to establish an outdoor video surveillance network on the premises of its manufacturing facility with a surveillance room located in a separate section of the building.

The surveillance room acts as the central hub for all control and monitoring of surveillance operations within the manufacturing facility. This is where the recorded video footage is reviewed and stored.

The initial path of connectivity with the on-site equipment is established over the building's communications infrastructure with cables running from the surveillance room equipment up to the LigoWave base station, which is deployed on top of the building.



In cases of corporations, organizations, institutions, and other large entities, surveillance networks are typically deployed in clusters, i.e. a single location will have multiple IP surveillance cameras deployed for full visibility with different points of view. In order to have simultaneous access to all camera footage, the data transfer equipment must be designed for point-to-multipoint scenarios.

For this reason, the base station deployed on top of the building must be equipped with a sector antenna, which provides areal coverage and connectivity with multiple devices concurrently.

The base station then establishes links with all of the LigoWave customer premises equipment (CPE) found within range. In some cases, this can involve up to 16 simultaneous video surveillance links.

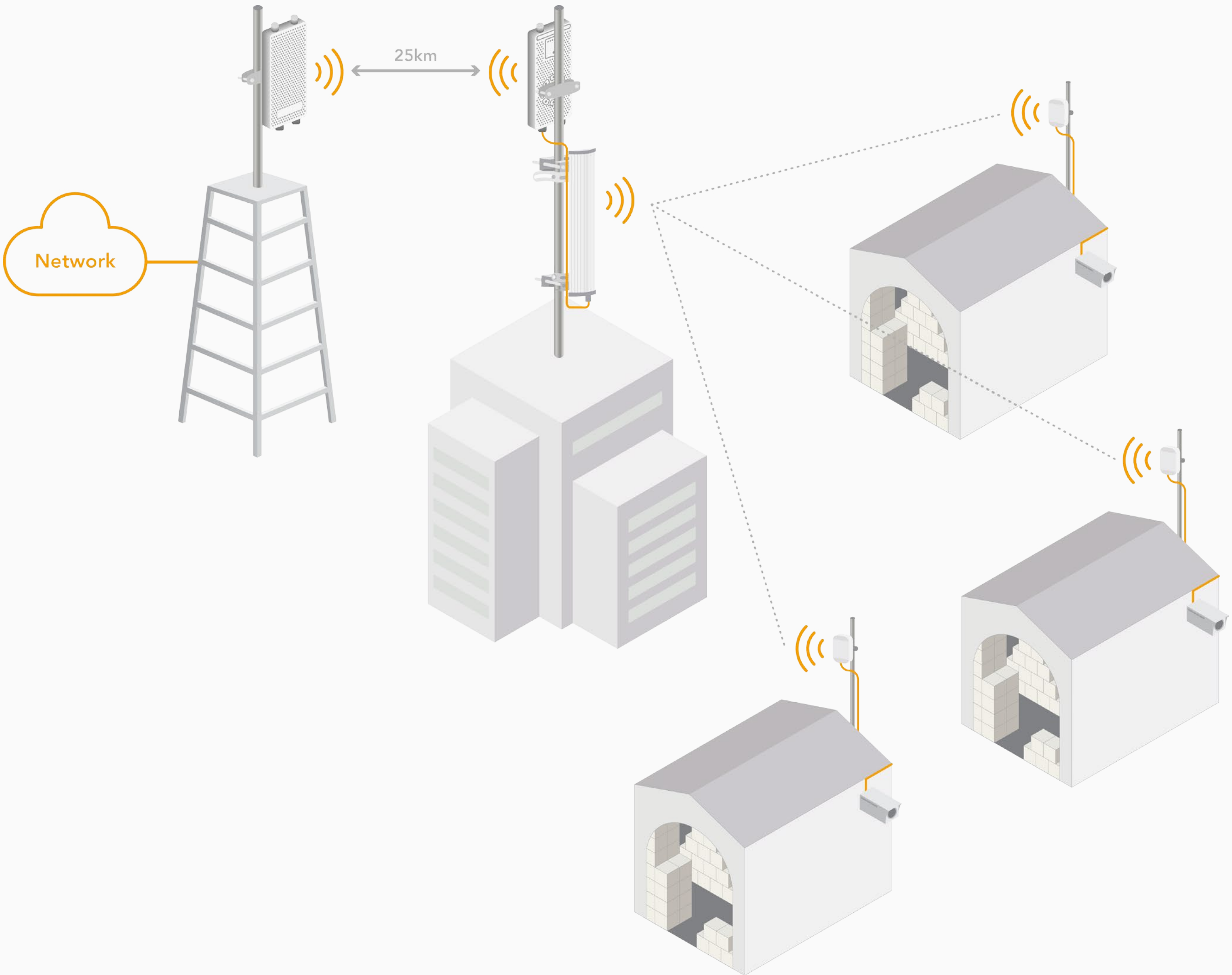
Lastly, each CPE is wired to one or more IP surveillance cameras, thus completing the chain of network connectivity. A PoE adapter is used to provide data and power to the CPE and another switch would have to be installed in case of multiple cameras connected to a single CPE.

As the IP surveillance camera records video footage, it is immediately sent to the LigoWave CPE over a cable. The CPE forwards the footage over a wireless link to the LigoWave base station, which then delivers it to the equipment found in the surveillance room.

Scenario Variations

The technical architecture of the scenario provided above may differ depending on the situation. For example, if the manufacturing facility was located 25 kilometers away from the company's headquarters, where it was decided to establish the surveillance room, then a solely-PTMP setup would not be enough.

In this case, there would have to be a point-to-point (PTP) link installed between the headquarters and the manufacturing facility. The surveillance room would be connected to the PTP device in the same way that the base station is in the exemplary scenario provided above. The PTP device would have a single direct link established with the PTP device deployed on the premises of the manufacturing facility. From here, the PTP device would be wired to the PTMP base station, followed by the same setup as in the example provided above.



There can also be slight variations in the entire setup depending on the scenario. Video surveillance of industrial premises may require more robust equipment with a higher IP rating and a metal casing, as opposed to a city street surveillance scenario where cost-efficiency and minimally-intrusive design might be the more suitable solution.

Technologies Involved

The main task of any video surveillance network is to provide a smooth and seamless video streaming service with strong security measures and maximized network efficiency.

This is achieved by implementing a handful of technologies:

Management Frame Encryption

Management frames are digital data transmission units developed to establish and maintain communication links between wireless data transfer equipment and to protect them against attempts at terminating the link.

There is a number of management frame subtypes, such as authentication, deauthentication, association, reassociation, beacon, and others. Each frame subtype performs a specific function and different management frames are sent based on necessity, e.g. authentication, association request and response frames are used in establishing a wireless link.

While data encryption is standard practice among wireless equipment manufacturers, management frame encryption, on the other hand, is not. Without management frame encryption, links are vulnerable to fake management frames that are sent out by devices outside of the network with the aim of maliciously terminating a valid session.

The IEEE 802.11w standard is generally applied to protect management frames.

The entire DLB Series, as well as all other LigoWave devices, come equipped with management frame encryption, which makes use of AES-128.

iPoll 3™ Proprietary Protocol

iPoll is a proprietary data transfer protocol developed exclusively for the LigoDLB Series. It employs CPE polling to eliminate data transmission congestion and close-cluster interference in wireless PTMP installations:

first, the DLB base station polls all connected DLB CPE, after which it sends a data frame and a token to one of the polled CPE. The CPE with the token then responds by sending a data frame back to the base station. Once the data frame is successfully received, the base station polls all CPE and performs the above process again.

In the absence of a system for coordinating data transfer, 2 or more CPE will frequently attempt to simultaneously communicate with the base station, which in turn will cause the CPE to back off for a random amount of time, this way stalling the transmission.

By providing structure and coordination to the way data is transferred, iPoll makes sure that there are no CPE collisions during transmission. This functionality is called uplink management.

iPoll also handles the activity of all connected devices by having DLB CPE that require less airtime listed as low activity or idle and having CPE that generate more traffic assigned to the active list. This function allows the base station to focus its resources on CPE that require more traffic to be transferred.

Activity lists are dynamic—CPE are assigned to different lists based on how much traffic they put through (measured in megabits per second [Mbps] or packets per second [PPS]).

The implementation of these processes leads to more reliable packet delivery, stabilized jitter, minimized latency, and more concurrent links with CPE per base station, resulting in increased throughputs and more efficient use of the channel and network resources.

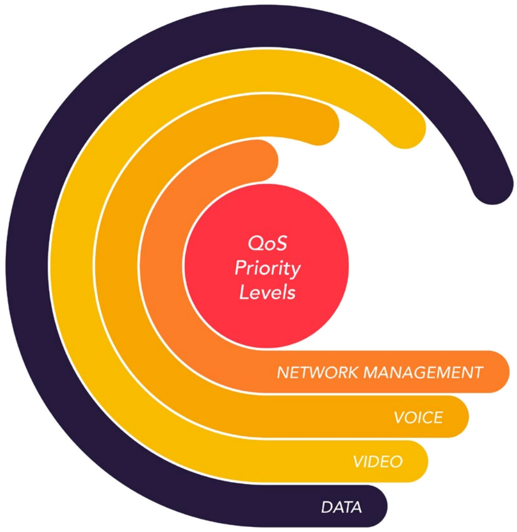
Quality of Service

Quality of Service (QoS) is a resource reservation and traffic prioritization mechanism that sorts and ranks traffic based on its type to ensure seamless flow of mission-critical and other data.

In LigoWave equipment, QoS sorts through four types of pre-marked traffic: network management, voice, video, and data (highest to lowest priority in that order). Each type of traffic is assigned a priority level with certain data thus being preferred and given more attention over other data during data transfer.

Without QoS, all data is treated equally and delivered to end-users on a "first come—first serve" basis. During periods of heavy internet use, users will experience choppy video playback, interruptions during voice calls, and generally slow internet speeds.

With QoS, on the other hand, traffic is differentiated and certain data packets are delivered more frequently than others. In turn, more immediate data—such as video and voice—reaches the end user at a pace that would guarantee playback seamlessness.



QoS is a must with IP video surveillance equipment sharing network infrastructure together with services such as internet access provision or intranet. In such a case, periods of greater network activity would have no effect on surveillance traffic, regardless of the amounts of other types of traffic.

All LigoWave wireless data transfer products come equipped Layer 2 (CoS)/Layer 3 (ToS/DSCP) QoS that makes use of weighted round robin (WRR)—an algorithm that guarantees that all types of data are sent in some proportional amount without any packet loss.

IP Multicast Support

IP (Internet Protocol) multicast is a computer communication technique in which data is transmitted from a single source (or in some cases from multiple sources) to a group of specific end devices over IP infrastructure. Only one transmission is performed on the source end, regardless of how many end devices receive it.

Example: as an IP surveillance camera records video, it immediately sends the footage to the DLB CPE. If the IP multicast function is enabled and the receiving group is specified, then the CPE replicates the original video signal and forwards it to each end device within the group.

IP multicast is useful in cases of multiple surveillance rooms.

Since IP multicast group lists can be dynamic, it is also possible to set up remote access so that users could join the surveillance stream at any time.

The multicast function can be enabled on any LigoWave device within the surveillance network—it does not have to necessarily be the device immediately following the camera.

To put things into perspective, there are also 2 other communication modes: unicast and broadcast. Unicast enables a one-to-one transmission with a single source and a single receiving end device. A broadcast allows one-to-all transmission with a single source and all receiving end devices within the network. LigoWave equipment supports all of these communication modes.

Case Studies

LigoWave has taken part in a variety of specialized IP surveillance projects. This includes surveillance of multiple urban and industrial zones as well as of public and private facilities.

Public Surveillance Project in Besançon, France

A small town on the outskirts of Besançon, France undertook a wireless video surveillance project. The objective was to deploy 12 high-definition public surveillance cameras in several locations around town.

All of the previously deployed surveillance equipment has become outdated and could no longer provide satisfactory video streaming results. Therefore, both the surveillance cameras and the wireless data transfer devices were replaced by modernized equipment designed for HD video over IP infrastructure.

The requirement was to implement a reliable cost-effective short-range (less than 3km) solution, for which LigoWave employed DLB 5-20n wireless data transfer devices.

The short distances among stations and the relatively small data traffic allowed for minimal-cost performance and the smaller loads meant lesser resource and utilization costs as well as extended device service time. The upgrade improved reliability, provided a higher functionality level, service longevity, and cost-effectiveness.

Surveillance of the Industrial Pho Noi Park Premises, Vietnam

The Pho Noi Industrial Park, located in the Hung Yen Province, Vietnam launched a project to deploy 23 surveillance cameras along the park's central road for public and traffic surveillance and security.

The requirements for this surveillance scenario were comparatively high: the wireless devices had to be resilient to harsh environments, to provide both high and stable performance, to come with a central management solution, and to be easily deployable, all the while maintaining cost-efficiency. Moreover, the wireless data transfer equipment had to be powerful enough to not be affected by the local flora.

LigoWave offered the DLBac Series as a solution to meet the scenario's requirements. The areal device layout included 23 surveillance cameras connected to 23 individual DLB 5-15ac CPE and spread out within an area approx. 1.2km away from 2 DLB 5-90-17ac PRO base stations.

The 5-15ac and 5-90-17ac combined met all of the requirements: IP ratings fit for industrial conditions, reliability and high performance guaranteed by time-tested hardware and software, and smart internal and external design for quick and easy installation and configuration.

Pollution Surveillance in Shenzhen, China

The Local Bureau of Environmental Protection in Shenzhen, Guangdong Province, China has taken upon itself to implement measures that would help to survey pollution levels in 10 of its pollution-sensitive areas with the ultimate aim of eliminating the sources and effects.

The project faced several challenges. Besides the limited budget provided by the authorities and the bureau's environmental policies regarding the cost of equipment use and maintenance, the selected area for pollution surveillance lacked the necessary wired infrastructure and the urban environment as well as changing pollution levels required careful network planning.

The decision was to employ 50 dome cameras hooked up to DLB 5-90 and 5-20 wireless devices, all powered by solar panels. LigoPTP 5-23 UNITY devices were used as the backbone of the network to ensure reliable video data transmission.

The combination of minimal infrastructure, quick and simplified setup, and centralized management system made this project a cost-efficient solution with fast return on investment. The 50 dome cameras and wireless data transfer devices were distributed in strategic locations around the city, enabling the Bureau of Environmental Protection to gather data for research and statistics. To prevent possible latency issues caused by environmental factors, the DLB devices came equipped with the iPoll Proprietary Protocol, which ensured coordinated and efficient data packet delivery from the cameras to the backbone devices.

Why LigoWave?

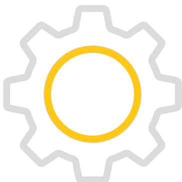
There is a handful of factors that lead customers to choose LigoWave wireless data transfer equipment[4]:

Security

Data protection is a key priority with any device that processes data. This is why LigoWave has integrated encryption mechanisms, such as AES-128, to ensure data transmission security over wireless links. This includes encryption of the data that is being transferred over the wireless link and of the management frames used for network management.

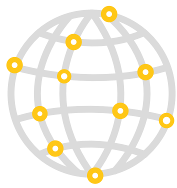
Reliability

The current DLB architecture has been implemented in more than 20 different device models over a number of years. The time-tested hardware and software employs proprietary technologies to ensure a high standard for data delivery, minimizing impeding factors such as latency, jitter, and environmental noise. Furthermore, DLB devices come with an IP rating of 65–67, which is a measure used to ensure device performance longevity.



Simplicity

One of LigoWave's primary aims is to simplify the factors and measures necessary for wireless connectivity. This is why the devices are made with all-in-one architecture, meaning that users do not have to have additional equipment or accessories for a successful wireless link[5]. Moreover, the casing is designed for mounting on walls and poles with flexible adjustment capabilities in multiple directions. Lastly, all LigoDLB devices come equipped with a user interface for configuration and management, which also includes wireless link adjustment, planning, and management tools, including Site Survey, Spectrum Analyzer, and Antenna Alignment.



Involvement

Collaboration is a core value of LigoWave. Collaborating is key to growth and improvement, which is why LigoWave invest into its distributors, resellers, and clients by providing equipment training courses, maintaining active business relations through regular meetings, providing customized technical, sales, and marketing support, and reacting to needs and feedback.

[4]Results retrieved from an internal LigoWave survey on why customers choose LigoWave, 2018.

[5]With the exception of models designed for external antennas, which are not supplied by LigoWave.