



WHITE PAPER

Using IBW to enable Commercial Smart Building Systems

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TABLE OF CONTENTS

Executive Summary

Pg 3

What is an In-building wireless network?

Pg 5

Why is a wireless network needed for building controls?
IBW network options

Smart building environments enabled by IBW

Pg 7

The importance of energy savings
Benefits of smart HVAC
Benefits of Smart lighting
Benefits of Smart Security

About iGR

Pg 11

Disclaimer

EXECUTIVE SUMMARY

New 'smart' commercial buildings have a central automation system to control all the main systems in the building. These control systems are split into several main functions:

- HVAC, indoor air quality, humidity and temperature
- People transport systems (elevators, escalators, moving sidewalks)
- Smart lighting and visual comfort
- Building access and security

These systems, when combined into building-wide analytics-based smart management system, benefit the tenants and building owners and managers in several ways:

- Improved air quality, including the ability to monitor the air for pollutants, together with temperature maintained throughout the building
- Changing airflow throughout the building based on pressure sensor data
- Count people, both tenants and guests, entering and leaving the building for use by environmental controls and emergency services
- Ability to deploy building security sensors and monitors, including video cameras and operate management systems for these devices, wherever they are needed
- Improved visual comfort through smart lighting that mimics daylight as much as possible
- Reduced operating costs by minimizing AC and lighting use in general and detecting when parts of the building are unoccupied. This obviously also reduces energy use. According to the U.S. Department of Energy, commercial buildings account for 40 percent of all U.S. energy use and 76 percent of all electricity use.
- Reduced carbon emissions – according to CNN Business, the real estate industry makes up 49 percent of global carbon emissions when including construction and building operations.

But to be effective, the central automation system will need a range of sensors and control and monitoring units around the building – individual lighting controls, thermostats, humidity monitors, security cameras, etc – and needs to be able to place these where needed. By using an in-building wireless (IBW) network each sensor can be wirelessly-enabled, so it can be located where needed, not just where the wires are.

An in-building wireless network provides a reliable radio signal anywhere inside the building such that the outside walls and windows of the building are not a problem

EXECUTIVE SUMMARY

(without an IBW, outside cellular signals may have problems penetrating inside the building resulting in inconsistent and unreliable connectivity inside the building).

IBW therefore allows tenants or guests inside the building to access Wi-Fi or cellular as needed and enjoy a higher-quality connection. This means the ability to reliably make phone calls, connect to critical communications, video conferences, and access corporate applications.

For commercial IBW networks, there are essentially four choices: commercial Wi-Fi, a cellular DAS (distributed antenna system), a private wireless network using CBRS or IoT networks. These can be deployed simultaneously or individually depending on the needs of the building systems, other tenant or building applications and the type of building construction. Specific IOT networks, using various LoRa (Low power Radio Access or Matter) protocols, can also be deployed to provide connectivity to low-bandwidth, low-power IOT (Internet of Things) devices.

Combining an IBW network together with the building central automation system amplifies the benefits of each solution: the IBW network provides connectivity for improved efficiency and productivity in the building, while the building central automation improves efficient and control for all the building environmentals. The same IBW network can support both connectivity solutions throughout the building and the building automation systems – one network can do it all, thereby significantly improving the ROI. **This is therefore a layered stack of technology solutions enabled by the single network.**

Sustainability and energy conservation are obviously very important considerations for any commercial building – buildings today are built to obtain a high LEED (Leadership in Energy and Environmental Design) score. Unfortunately, a good LEED score in a building usually means that radio signals will transmit poorly throughout, the building. For the building owner or tenant wishing to install IBW, therefore, it is very important to select a vendor that has experience working in new buildings with high LEED scores to maximize the design of the network and ensure that the targets for coverage and capacity are met.

WHAT IS AN IN-BUILDING WIRELESS NETWORK?

Simply put, an in-building wireless (IBW) network provides radio signal coverage inside a building. Because radio signals do not travel well through walls or glass, the cellular service from a mobile phone, for example, available inside a building is usually poor.

So, while a person may enjoy a good cellular connection on their mobile phone outside a building, as soon as they walk inside the lobby, the number of bars (declines significantly. Move further inside the building and you will likely lose the cellular connection completely.

To address this issue, the solution is to deploy an in-building wireless network – the radio signal is now transmitting inside the building and hence the outside walls and windows of the building are not a problem Why is a wireless network needed for building controls?

One of the major benefits of an IBW network is that multiple applications and services can be supported by a single network, thereby creating a layered stack solution. Thus, separate networks are not needed for environmental controls and building security systems, for example – one network does it all. This significantly improves the ROI of the IBW but also means that the in-building network must be carefully designed to support all the possible applications and services. It is therefore important to look for a vendor that is technology-agnostic and can provide complete range of solutions: cellular; Wi-Fi; and wired, and has experience working in new buildings with high LEED scores to maximize the design of the network.

IBW therefore allows a wide range of devices (including environmental and light controls) inside the building to access Wi-Fi or cellular as needed and enjoy a higher quality connection. This means the ability to reliably connect to critical communications and devices, and, of course, created a layered stack environment of multiple applications and services supported by a single IBW network.



IBW Network Options

For commercial IBW networks, there are essentially four choices: commercial Wi-Fi, a cellular DAS (distributed antenna system) or a private 5G/LTE network using CBRS or IoT networks:

Wi-Fi is of course widely available in commercial and residential environments and is typically used to provide general wireless connectivity throughout a building. Since a wide range of Wi-Fi devices are available, everything from a thermostat to a laptop can be connected.

Private cellular network, using 4G LTE or 5G, uses the same technology as the large cellular operators but deployed at a much smaller scale. In the U.S., the CBRS band allows building owners, tenants and enterprises to build, deploy and operate their own cellular network, independent of the mobile network operators.

DAS (distributed antenna system), as the name suggests, takes a cellular signal and spreads it throughout a building. Essentially, a cellular signal is taken from outside the building and then rebroadcast inside. A DAS can also support multiple carriers inside the same building.

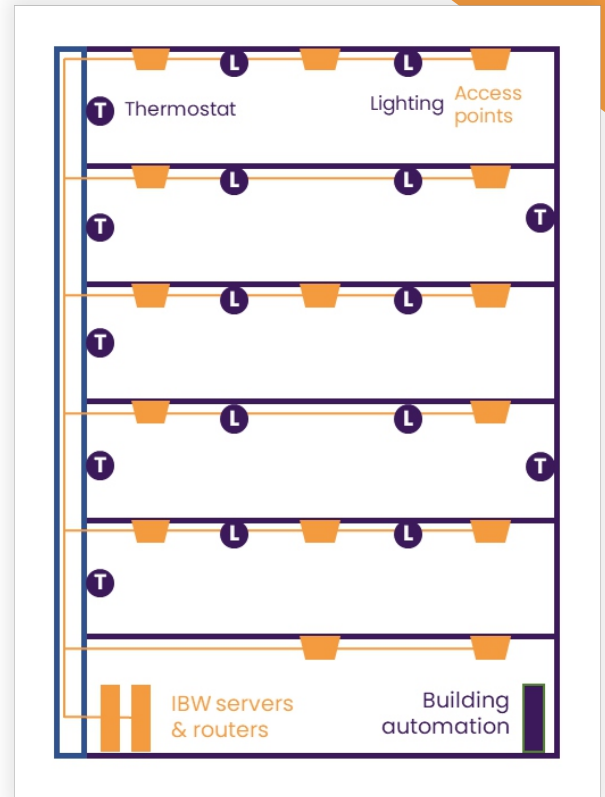
Specific IOT networks, using various LoRa (Low power Radio Access or Matter) protocols, can also be deployed to provide connectivity to low-bandwidth, low power IOT (Internet of Things) devices.

SMART BUILDING ENVIRONMENTS ENABLED BY IBW

New 'smart' commercial buildings have a central automation system to control all the main systems in the building.

These control systems are split into several main functions:

- HVAC, indoor air quality, humidity and temperature
- Smart lighting and visual comfort (blinds, etc)
- Building access and security



But to be effective, the central automation system will need a range of control and monitoring units around the building – individual lighting controls, thermostats, humidity monitors, security cameras, door access controls, etc – and needs to be able to place these where needed.

Before IBW networks, this meant having a physical wire to each control and sensor. But now with IBW, each sensor can be wirelessly-enabled so it can be located where needed, not just where the wires are.

The use of an IBW to provide connectivity around the building enables sensors and controls to be added as needed as the building changes. For example, if a floor is subdivided for a new tenant, lighting controls and thermostats can be added to the new area for individual control of that area, as well as new security access locks and controls. And air quality sensors can be added in new area to maintain quality, along with new HVAC vents, etc.

SMART BUILDING ENVIRONMENTS ENABLED BY IBW (CONT.)

And, of course, the IBW network used to support the building automation systems can also provide connectivity for other applications and services creating a layered stack. This improves the ROI of the IBW network since the utility supporting multiple services. Using an IBW to connect all of the sensors and controllers allows the data to feed an analytics platform that then forms the basis of a learning, analytics-based building control system. Using machine learning, the building will improve its responses over time and more accurately control the building environmental based on tenant behavior, weather and other factors.

The building managers and owners are also able to gain more analytical data on the performance of the various systems and then make changes to further improve tenant comfort, energy efficiency and operating cost. And the systems can count people, both tenants and guests, entering and leaving the building for use by environmental controls and emergency services.

All of this is only possible once an effective in-building wireless network has been deployed to support all of the necessary sensors and controllers.



THE IMPORTANCE OF ENERGY SAVINGS

Some of the main benefits of smart building system are energy savings.

Why is this important?

Consider that:

- According to the U.S. Department of Energy, commercial buildings account for 40 percent of all U.S. energy use and 76 percent of all electricity use.
- The EPA's Energy Star says that energy use is the single largest operating expense in commercial office buildings at about 30 percent of typical operating budgets and almost 20 percent of the nation's annual greenhouse gas emissions.
- According to CNN Business, the real estate industry makes up 49 percent of global carbon emissions when including construction and building operations.
- And in another example, the Institute for Market Transformation (IMT) says the entire building sector (commercial and residential) is the largest single U.S. sector for energy use, responsible for 40 percent of the total.

Many U.S. cities, counties and states are now implementing legislation and regulations that require buildings to benchmark and disclose their energy use, including Washington D.C., Austin, Atlanta, Boston, Chicago, Denver, Los Angeles and New York City. This allows energy use to be compared between buildings in different locations and the disclosed to the various partners, tenants and investors during transaction negotiations.

The result is that benchmarking and disclosure can increase competition between buildings and save energy. Pressure also increases on buildings that perform poorly in energy use benchmarking, increasing the need for smart building energy solutions, and, by extension, the in-building wireless networks needed to support the systems and analytics.

Note that federal investment is available for commercial building owners aimed at improving sustainability. These funds can be used to pay for infrastructure, including the in-building wireless network and building automation systems, and/or secure carbon credits.

Finally, a complete IBW/building automation/data analytics solution can facilitate compliance with near-term ESG regulations.

BENEFITS OF SMART HVAC

Deploying a smart HVAC and air quality system, enabled by an in-building wireless network, has several benefits for the builder owner and tenants:

- Obviously, improved air quality is one of the main benefits. This is usually accomplished by adding fresh conditioned air from outside the building, blended with recycled air to obtain the best combination.
- Air is monitored for pollutants and then filtered as necessary – this has become especially important in a post-Covid world. Pollutants that can be detected include pollen, mold, dust, microbes and excessive carbon dioxide.
- Temperature is obviously one of the most important elements of building comfort that is maintained by the HVAC system. But smart systems can maintain the same temperature across the building and between shaded and sun lit sides of the building, thereby minimizing AC use and avoiding 'freezing out' one part of the building.
- Changing airflow throughout the building based on pressure sensor data.
- Reduced operating costs by minimizing AC use in general and detecting when parts of the building are unoccupied. This obviously also reduces energy use.

BENEFITS OF SMART LIGHTING

The main benefits of smart lighting in a commercial building are reduced energy use and therefore lower operating costs. But an intelligent lighting system, connected via the IBW, will also learn the tenants behaviors and will mimic daylight as much as possible, thereby improving visual comfort.

This is achieved by:

- Making automatic adjustments to lighting in each part of the building based on tenant behavior, sunlight and weather conditions –this includes being able to dim lighting when direct sunlight is falling inside a specific part of the building
- Turn off lights when an area of the building is unoccupied
- Use dynamic window shades, monitored and controlled by sensors around the building, to reduce direct sunlight, blocking ultraviolet light and reducing cooling costs.

BENEFITS OF SMART SECURITY

Smart security and access controls enable the buildings owners, managers and tenants to not only control who can enter the building, but also account for all the people, both tenants and guests, in the building. For emergency services, knowing how many people are in the building, where they are and who they are, can be potentially life-saving in the event of an emergency incident.

Smart security systems also include the use of video camera, image recognition software and the associated localized computing to monitor public and sensitive spaces in the building, parking garages and exits and entry points.

With an IBW network, building security sensors and monitors, including video cameras, can be deployed wherever they are needed, not simply where a wired network access point exists. This gives the building managers and tenants far more flexibility in how they deploy and operate smart security systems in the building.

ABOUT iGR

iGR is a market strategy consultancy focused on the wireless and mobile communications and digital infrastructure industries. Founded in 2000 by Iain Gillott, one of the industry's leading analysts, iGR researches and analyzes the impact new wireless, mobile and digital infrastructure technologies will have on industries, the competitive landscape and on a company's strategic business plan.

A more complete profile of the company can be found at <http://www.iGR-inc.com/>.

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