Intesis®
BY HMS NETWORKS

Harnessing the power of the right air conditioning connectivity in the hotel industry

Contents

Introduction

In the hotel industry, air conditioning (AC) systems are the biggest energy consumers, representing on average more than 40% of the total energy bills.

Implementing the correct control and monitoring of the AC systems is key to reducing energy bills and improving guest comfort.

AC equipment use a range of different (and proprietary) protocols and communication standards, which present various challenges to the system integrator.

Furthermore, there is more than one approach to integrate the air conditioning equipment into the building management and guest room management systems.

Both above elements add a degree of complexity for the system designer, who must make the decision on the architecture of the integration, which has a major impact on the system's reliability and comfort.

This whitepaper aims to address the different options available to the system integrator and discusses the merits and demerits of each.

The relationship between guest comfort and hotel popularity

Providing a consistent, reliable, and comfortable hotel stay is critical to ensuring the popularity and loyalty of the guest to any hotel. Thermal comfort and indoor air quality are key parts of such an experience. An Experimental Study of Thermal Comfort and Indoor Air Quality- A Case Study of a Hotel Building (Ref 1), claims a direct link between the indoor environment and hotel popularity. It notes that -

"Analyzing the quality of the indoor environment is crucial, especially in rooms where users spend a significant part of their day...The quality of the environment in hotels' rooms is essential, as it determines the popularity of the hotel, thus the number of guests and the resulting economic benefits."

The same article also notes that -

"A detailed analysis is extremely difficult due to the possibility of opening windows by users, the irregular presence of hotel guests in the rooms, and the inability to verify the exact number of users in the room during the measurements."

It is therefore of paramount importance that the system designer makes careful consideration of all elements related to integrating air-conditioning systems into the building and guest room management systems, to ensure the best thermal comfort and reliability for the guests.

The role of Building Management & Control Systems

Hotels deploy many devices and technologies to control and monitor different parts of the building for lighting, temperature & humidity control, security, access, and the presence of personnel. But typically, all this equipment uses different protocols and communications standards.

The Building Management System (BMS)/ Control System receives and transmits information to and from many sources, such as the fire system, lighting, and room occupancy. The BMS/Control System can also open and close doors and shut off other devices or complete areas as it deems necessary. In addition to the above-mentioned sub-systems, a BMS/Control System is typically managing all elements of the Heating, Ventilation and Air Conditioning (HVAC) system.

HVAC systems represent the highest cost in a hotel's infrastructure, so controlling them is a priority. The cost of air conditioning, lighting and water can in some cases be as much as 60%-80% of a hotel's total running costs. Especially in extreme weather conditions, AC is the biggest energy consumer, on average representing more than 40% of the total.

Control of air conditioning and heating must be carried out both in common areas such as lobby, restaurants, reception, restrooms, as well as in private areas like guest rooms. Limiting the setpoint temperatures in public areas such as main rooms or large rooms can be very useful.

> *"Especially in extreme weather conditions, AC is the biggest energy consumer, on average representing more than 40% of the total."*

But it is important as well to prevent wastage of energy from the AC system in the guest rooms, for example, wastage caused by leaving windows open while the AC is on, or having the AC running in unoccupied rooms, which leads to over-consumption.

It is especially important to monitor and control energy consumption during periods of maximum hotel occupancy. Significant gains can be achieved when hotel services are working at full capacity, with laundries, kitchens, restaurants and dining rooms operating extended hours.

Having control of on / off status, fan speed and set point temperature is the main driver in energy saving. From a maintenance perspective, being able to monitor detailed information on errors and alarms in real-time allows service teams to take immediate action to resolve issues. This improves guest comfort and reduces repair expenses.

Protocols for BMS/Control systems in the Hotel Industry

In the hospitality industry, the three main protocols used by a BMS/Control System are BACnet, KNX and Modbus.

BACnet is a communications protocol for building automation and control (BAC) networks that use the ASHRAE, ANSI, and ISO 16484-5 standards protocol. Its popularity is increasing progressively. It was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control (HVAC), lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms for computerized building automation devices to exchange information, regardless of the service they perform.

KNX is an open standard (see EN 50090, ISO/IEC 14543) for commercial and domestic building automation. KNX devices can manage lighting, blinds and shutters, HVAC, security systems, energy management, audio video, white goods, displays, remote control, etc. KNX evolved from three earlier standards.

Modbus is a data communications protocol originally published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs). Modbus has become a de facto standard communication protocol and is now a commonly available means of connecting industrial electronic devices. Modbus is popular in industrial environments because it is openly published and royalty-free and places few restrictions on the format of the data to be transmitted. It has become a standard where Industrial Automation Systems (IAS) or Building Management Systems (BMS)/ Control System are needed.

> *Main players in the industry have product lines compatible with BACnet, KNX, and Modbus.*

AC integration into BMS/Control systems – the two different approaches

Integrating an AC system into the building management/Control system offers several advantages:

1. Monitoring and control over the air conditioning energy consumption – reducing the running cost of the hotel without compromising guest comfort. It is estimated that hotels with air conditioning systems integrated into the building management/ Control System and guest room management systems can save up to 20% energy compared to hotels with their air conditioning systems working through stand-alone controls.
2. Insights and control over the air-conditioning system health - ensuring longevity and reliability of the AC equipment, as well as a consistent guest experience.

There are two ways in which AC systems may be integrated with the BMS/Control System.

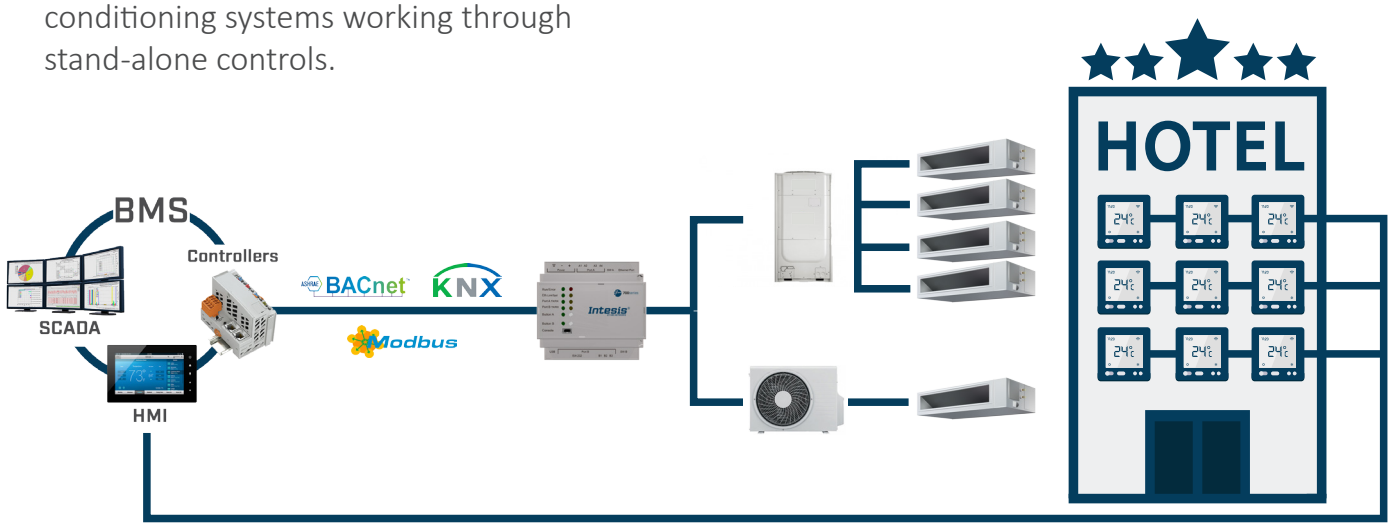


Figure
(a) Centralised interface configuration (Fig 1)

Here, the AC systems in all the rooms are connected to the control system using a single protocol translator gateway; all room controllers are connected to the same control system.

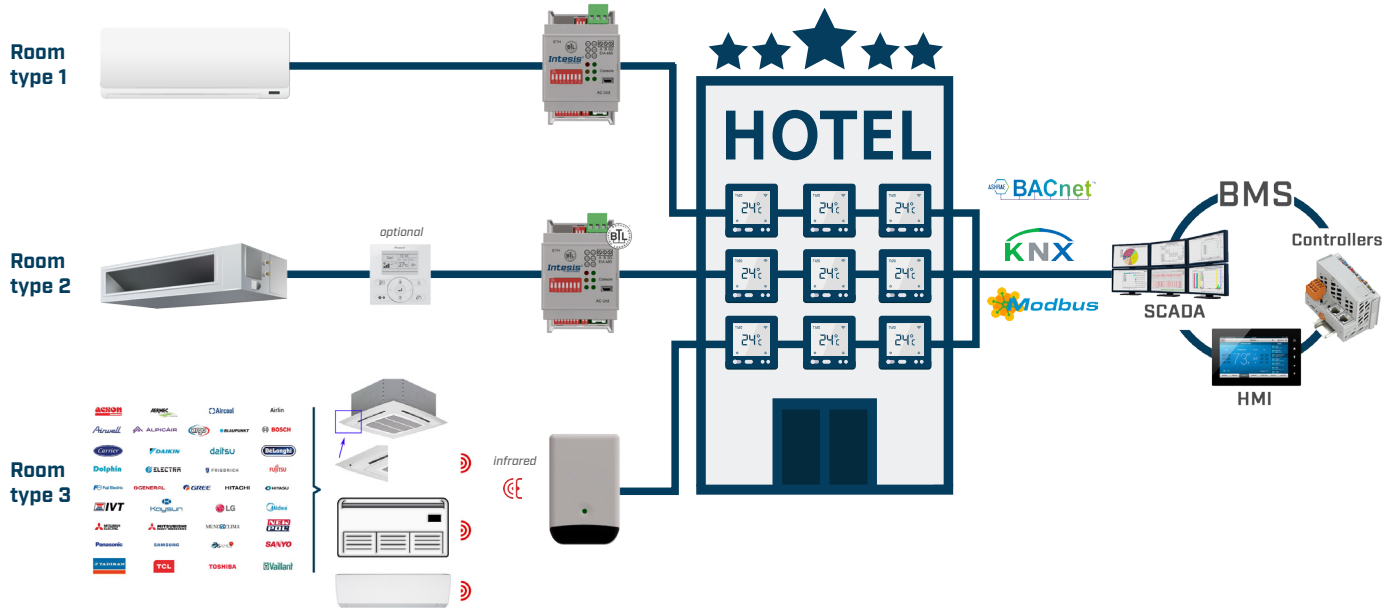
Key features are:
- Communications relies on the system backbone
- Infrastructure reliability plays a key role

The room controller does not communicate directly with the AC system, but information flows via the communications backbone to the BMS/Control System, which then communicates with the centralized AC interface, thereby providing centralised control. Individual indoor units are controlled through the central interface. The information flow in Fig 1 is bidirectional: from the room controller, via the communications backbone to the BMS/Control System, and then to the HMS gateway and eventually to the AC system itself; and from the BMS/Control System to the room controllers.

The wiring hardware and programming software in such a system are relatively simple, though the distances can be large and the wiring extensive, especially in a large hotel with several hundred rooms. The control of each indoor unit allows main functionalities, to be set, such as operating mode, on-off, setpoint and fan speed. The “pre-comfort” status can be set when the room is not occupied.

However, if wiring and programming are not done properly, networks can get overloaded, especially when there is a high occupancy level, leading to a delay of even up to a minute or two for the system to respond. This means that guests may be confused as to whether their commands have been acted upon. This leads to a bad guest experience and possible loss of reputation and revenues. These days, the former is openly expressed on social media, while in extreme cases a guest may refuse to stay in the room, leaving the room unoccupied.

Other problems might include faulty network infrastructure, defective cabling, poor system programming, or interference from spurious or unshielded electromagnetic signals (EMC). On top of that, if something happens to the backbone cable, network switch, or the BMS/Control System itself, all the rooms may be disconnected from the BMS /Control System, leading to the unavailability of the air-conditioning system within the entire zone or the building.



Figure

(b) Direct connection between Room Controller and AC in each room (Fig 2)

An alternative configuration- which is increasingly preferred- is to have every room controller individually connected to the AC indoor units of that room, using one gateway per indoor unit (one per room in the example shown in Fig 2). Again, information is sent to and received from a central BMS/Control System to the room controller and vice-versa.

Compatible with most AC brands, the key features are:

- Avoids any delay in communication between the AC system and the room controller; guests get an instant (under 1s) response to their commands, increasing convenience and comfort.
- Different configurations are possible in different rooms and set by the guest.
- Substantial energy savings are possible by triggering events like “pre-comfort mode” when the room is unoccupied.
- Sometimes a window sensor/occupancy sensor is included so that if for whatever reason, the guest leaves the window open, the system can be automatically turned off by triggering the window contact function available. This adds to the substantial energy savings possible in this configuration.

There are three gateway options, shown from top to bottom in Fig 2:

- A brand-specific gateway for RAC units (Room Air Conditioner), developed in conjunction with the main AC manufacturers- gateways have different connection ports and hardware, depending on each AC brand available port.
- A general option compatible with any AC unit having IR communication.
- A brand-specific gateway for VRF (Variable Refrigerant Flow) developed in conjunction with the main AC manufacturers- again, gateways have different connection ports and hardware, depending on each AC brand available port.

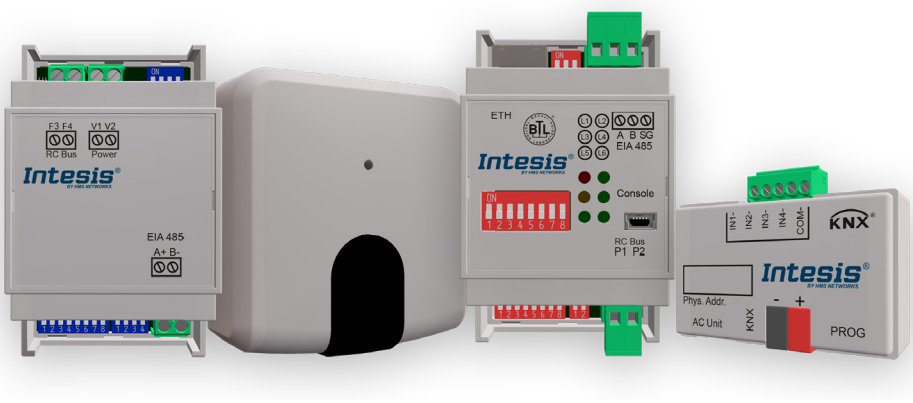
By utilizing a direct connection between the room controller and the AC in each room, we remove the bottleneck of using an infrastructure that’s common to the entire building and all services, thereby ensuring a prioritized control and monitoring of the air conditioning system, leading to the ultimate comfort and reliability.

The need for the right AC interfaces and Protocol Translators

Since air conditioning equipment from different manufacturers uses different proprietary protocols and communications standards, enabling the different systems to talk to one another is a challenge, while still accommodating the many different requirements of each hotel project.

Intesis by HMS Networks, with a global base of over a million AC units integrated in homes and buildings globally, provides AC interfaces, protocol translators and cloud solutions for bidirectional integration of the air conditioning systems with the main communications protocols used in buildings. Intesis AC interfaces provide a reliable means to read and control the most important parameters of any AC unit. The interfaces are developed in collaboration with the AC manufacturers ensuring reliable, out-of-the-box integration. These interfaces are connected directly to the AC unit's communication bus. HMS Networks also has a Universal Controller which grants compatibility with any AC model that has an IR receiver and is controlled via a wireless remote controller.

Via the Intesis gateways, inputs for supervision and control from sensors are integrated into a single system, allowing thermostats and touch panels to control all the "room triggering scenarios"; they can be used to turn the AC unit on or off automatically and adjust the setpoint temperature. Using similar connection technology, it is also possible to control lighting, blinds, and the TV system. Using the KNX or DALI protocols, lighting is typically connected to the room controller and/or to a BMS/Control System directly, or, when the protocols used by the room controller and/or the BMS/Control System are different, via an Intesis DALI-to-BACnet or KNX-to-BACnet gateway (BACnet being the BMS/Control System protocol in this example).



Cloud control

Driven by the fast adoption of internet technologies globally, demand is growing in the home and building automation markets for smart cloud-based device connectivity.

Modern buildings include equipment from many different vendors that need to be interconnected, so they can provide property owners with control and supervisory opportunities. With ST Cloud Control from Intesis, any Modbus and BACnet device (such as a room controller) can be accessed via a web browser or by using a native app for Android and IOS devices.

ST Cloud Control aims to help medium-sized projects to get their management system ready in a very easy and intuitive way. Advanced expensive computers are often needed in conventional installations so the BMS/ Control System can run, while with ST Cloud Control, any computer can be used if it has a web browser with internet access. This web dashboard is responsive, so it can be easily accessed from any device.

ST Cloud Control gateways are configured using the Intesis MAPS (Multi Addressing Points Solution) Windows configuration tool, developed to configure and monitor the latest Intesis gateways. MAPS supports all the protocols available for Intesis gateways, providing an easy, consistent way to program all integrations, regardless of the protocol they use.

MAPS is a very intuitive tool, offering interesting and advanced functionality. Once the gateway is configured, connected to the cloud, and assigned to a user account, the devices connected to the gateway will appear automatically in the dashboard, showing all specified widgets. This specific feature is much appreciated by the system integrators, since they are saving time, there is no need to spend time configuring the dashboard to show all the desired devices and signals. It is especially valuable for installations in geographically dispersed locations.

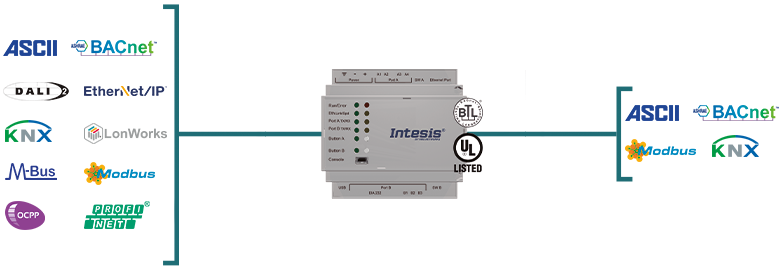
With AC Cloud control by Intesis, an individual AC interface is connected to each indoor unit and then showed on a dashboard. Depending on the user profile, some or all indoor units are displayed and can be controlled. In their local language, guests can control their AC system from an app on their Android or iOS smartphone. Remote control capabilities include; On/Off, Operation Mode, Temperature Setpoint, Ambient Temperature Value, Fan, and Vanes Control.

Reference

An Experimental Study of Thermal Comfort and Indoor Air Quality — A Case Study of a Hotel Building
Marek Borowski, Klaudia Zwoli?ska and Marcin Czerwi?ski
Faculty of Civil Engineering and Resource Management, AGH University of Science and Technology, 30-059 Krakow, Poland
Energies 2022, 15(6), 2026; https://doi.org/10.3390/en15062026

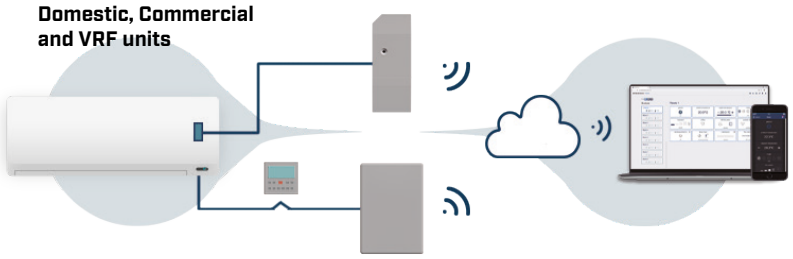
In summary - HMS solving the key hotel air conditioning challenges

Protocol Translators



AC Interfaces

Cloud Solutions



HMS Networks is taking on the challenge of enabling the different systems to talk to one another via Intesis gateways from HMS Networks. A single system allows all the “room triggering scenarios” to be controlled. There are two possible configurations for connecting the AC system with the room controller:

- Centralised interface configuration (Fig 1)
- Direct connection between room controller and AC in each room (Fig 2)

From a maintenance perspective, being able to monitor detailed information of errors and alarms in real time allows service teams to take immediate action to resolve issues.

Appendix - A Glossary of AC terms

A Residential Air Conditioner (RAC) is attached through a wall or in a window and only cools and/or heats a single room. The air is distributed through a vent on the front of the unit.

A Precision Air Conditioning (PAC) system is one designed for cooling datacentre and server room environments rather than one designed for general building (homes, commercial offices and retail).

Variable Refrigerant Flow (VRF) air conditioning systems (VRF) describes a configuration where there is one outdoor condensing unit and multiple indoor units.

Many people mistakenly believe that VRV and VRF are two different HVAC technologies. Actually, VRV and VRF are two different terms for the same HVAC technology. Based on Inverter technology compressors, the first VRV HVAC systems were invented by Daikin during the early 1980s.

As a technology leader in the HVAC industry, Daikin registered the VRV term (which stands for Variable Refrigerant Volume) as an official trademark. All other companies use VRF (Variable Refrigerant Flow) for their similar HVAC systems. Eventually, VRF became the more common term for these types of systems. This is the term that HMS uses in its communications.

What is VRF then?

VRF describes a very sophisticated AC system, based on several principles:

- **Refrigerant only** – where refrigerant is the only coolant material in the system (in contrary to the chilled water systems, where refrigerant is used for cooling/heating the water that is circulated throughout the whole system)
- **Inverter compressors** that allow lowering power consumption with partial cooling/ heating loads
- **Several air handlers** (indoor units) on the same refrigerant loop/circuit
- **Ability of modular expansion** (especially applicable for large projects, that can grow in stages)
- **A typical system** consists of an outdoor unit (comprising one or multiple compressors), several indoor units, refrigerant piping running from the outdoor to the indoors, using Refnet Joints (copper distributors in pipes) and communication wiring.
- **Communication wiring** comprises a two-wired cable chained from the outdoor to all indoor devices, creating an internal closed loop network. This is an essential part of any VRF installation.
- **Each indoor is controlled by its own wired control panel,** while there are some possibilities for wireless remotes (IR) and centralized controllers, enabling controlling all indoors from one location.

How does VRF work?

The operation logic of the VRF is fully built-in inside the system and is proprietary for each VRF manufacturer. The system gets inputs from the user (e.g. desired comfort temperature) and from the surroundings (outside ambient temperature). According to that data, it implements its logic to get to the desired comfort conditions utilizing optimal power consumptions. The ability to adjust itself to the outdoor conditions is one of the main factors that makes these systems so efficient, compared to the traditional water-cooled systems, based on chillers and fan coils.

VRF types:

- **Cooling Only systems** (less popular) – those systems can only cool. Heating is not available. Fan and Dry modes are available for each indoor unit independently.
- **Heat Pump systems** (most popular) – all the indoor units can either heat, or cool (not at the same time). Fan and Dry modes are available for each indoor unit independently.
- **Heat Recovery systems** (less popular)- those systems are the most sophisticated ones, where cooling and heating may be available by each indoor unit, independently, at the same time.

Reference
Front cover room control images supplied by: www.polarbeardesign.co.uk Tel: +44(0)1635 945700

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