Building Automation

Proposed Building Automation System,

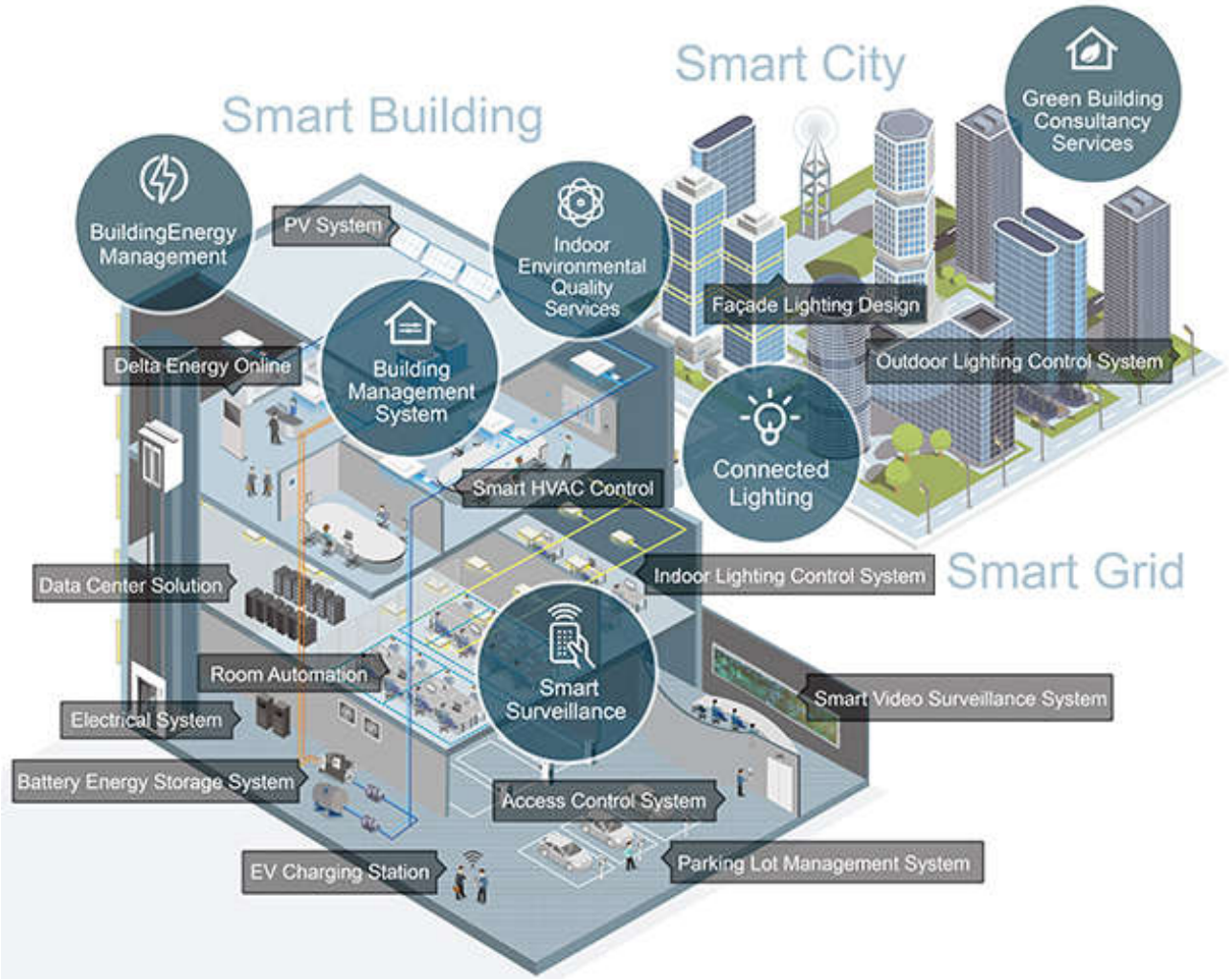
The goal is to automatically manage and control the building's systems.

The term Building Automation refers to the science of automating the functions of a building's systems. The goal of Building Automation is to optimize the structure's performance and increase levels of livability, comfort, and safety within its environments.

Building Automation systems are technologies that allow for complete and centralized management of the various systems in a structure, be it residential, service, or production.

These systems are essential components of Smart Buildings, i.e., buildings equipped with integrated and advanced technologies that make the design, construction, and operation of the building itself more efficient. These technologies can be applied to new or existing buildings.

Managing systems in an integrated and automated manner can bring several advantages in terms of energy savings, comfort, and occupant safety.



Building Automation and home automation

Building automation and home automation may seem like similar concepts, but there are actually differences between the two. The goal is the same—to improve people's quality of life in their environments—but the difference lies in the scope of their application.

Home automation refers to the domestic environment and the ability to manage or, better yet, control devices within your home (appliances, lighting, shutters, etc.) in on-off dimmer mode;

Building Automation, while including home automation services, is more oriented towards improving a building with technologies that allow for the management of technological systems, communication networks, and IT networks that interface with public networks.

In contrast, home automation is a command-based automation system, with no coordination. It is characterized by limited functionality, small/medium size, and a simple user interface. Furthermore, it requires little engineering and simple configuration tools.

In building automation, we can define management objectives based on the same set of requirements. Conversely, home automation (or domotics) focuses on specific tasks that, in simplistic terms, we might identify with electric shutters or lighting.

We can say that home automation is a "smart home," while building automation is a "smart building." To make an entire building "smart," it's necessary to install specific systems. These systems typically consist of devices controlled by software that can process information using specific technologies.

A Building Automation system can be used in a building to manage:

- control of thermal and electrical production;
- water management systems (not only hot water, but also maintenance of the piping system as regards the building's own plumbing network)
- all facilities, from air conditioning and ventilation systems to heating systems, heating systems with air conditioning control and management (thermoregulation);
- the control and management of lighting and motors in general;
- access control;
- alarms, notifications, maintenance;
- data collection, analysis and export.

In a company, for example, building automation systems can be used to monitor access to various areas, managing the presence of personnel within an environment and reducing the risk of human/machine collisions, thus ensuring the safety and protection of occupants.

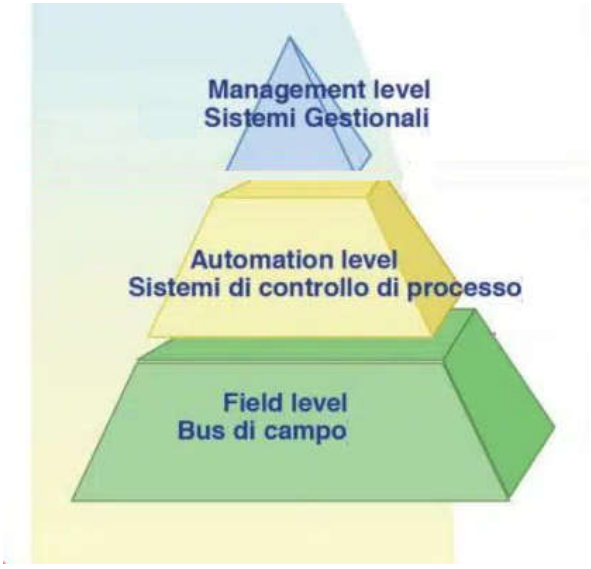
Intelligent building automation systems can be used in offices to manage lighting and room temperature based on external weather conditions or the number of people present inside.

An intelligent management system can also offer many advantages in hospital environments. Building Automation makes it possible to manage queues for medical appointments, as well as control access to facilities, air conditioning, and more.

The advantages of the proposed project

Building Automation allows for significant energy savings by regulating all energy consumption within the building, preventing waste or energy loss. This translates into greater energy efficiency and cost savings on utility bills, unlike traditional systems. This also helps promote environmental sustainability by avoiding excessive energy consumption.

Building Automation systems are therefore the control systems that enable optimal management of the technological subsystems that comprise smart buildings. This definition encompasses both automation technologies (i.e., all sensor technology) and more plant-based technologies.



The first level, *the Field level* , of this "automation pyramid" consists of hardware devices, such as sensors, chillers, valves, fans, and room control. It is this hardware that generates and collects, via fieldbuses, data and information relating to the building's systems.

At the second level of the pyramid, *the Automation level* , we find automation controllers. These collect parameters from various sensors (now also wireless), process them, and use them to control actuators, also based on the program or control technique.

The last level of the pyramid, *the Management Level* , is most commonly found in commercial buildings. It is at this level that we find Building Management Systems (BMS), and more specifically, Building Energy Management Systems (BEMS), the management systems for smart buildings. These complex and generally expensive systems are not typically used in condominiums and private homes, but are now becoming increasingly attractive for residential buildings as well. These BA systems are characterized by extensive

functionality and the highest level of integration. These features are complemented by high levels of customization and integration, as well as complex configuration tools.

A European Commission report highlights that buildings are responsible for 40% of energy consumption and 36% of CO2 emissions in Europe.

Data shows that European buildings are old and inefficient. Thirty-five percent of them are over 50 years old, and 75% are energy inefficient. For this reason, the European Sustainable Development Strategy allocates significant funds to a veritable "renovation wave" of buildings.

Evaluation of the advantages in the proposed class A system

Is it possible to estimate the benefits of a Building Automation and Control (BAC) system? UNI 15232 classifies buildings into four classes based on their Building Automation and Control (BAC) systems.

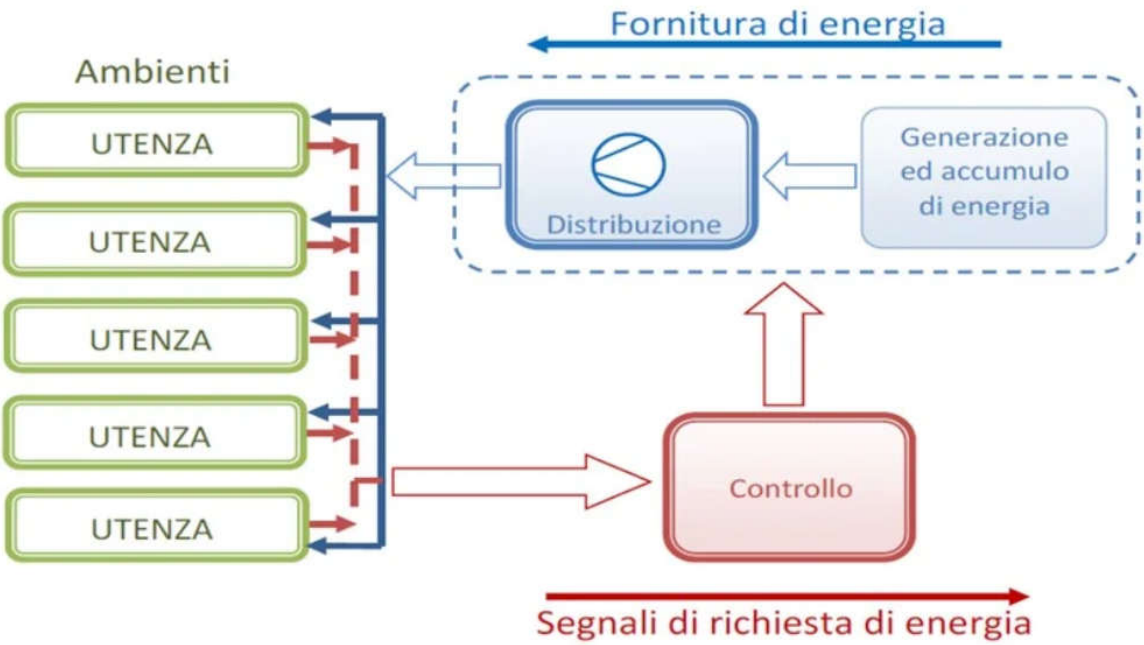
At the lowest level is **class D** , that is, those systems without automation and control that are not energy efficient.

Class **C** , on the other hand, refers to systems with a minimum level of automation. These are systems built with traditional systems, where communication buses with basic functions may be present. This class is considered the reference standard for national regulations.

At the next level, **class B or "advanced,"** buildings are equipped with advanced automation systems with Technical Building Management (TBM) capabilities. These enable centralized and coordinated management and control of the various systems.

Finally, in **class A or "HIGH ENERGY PERFORMANCE",** with high energy efficiency, there are buildings equipped with highly energy efficient BAC and TMB systems.

Building Energy Management System (BEMS) is a system or platform for managing buildings, monitoring real-time energy consumption and the performance of the building-system throughout its life cycle. Air conditioning and heating systems account for the majority of a building's energy use (and often waste). BEMS operates on two levels: control and efficiency. Using data collected by building sensors, system anomalies can be identified, such as when the system is operating when it shouldn't be. Based on consumption analysis, its algorithm reduces energy overproduction, allowing the system to produce only the amount of energy needed. This technology can be applied to new or existing systems and allows for an estimated 20 to 40% reduction in consumption. Furthermore, the system can also be monitored remotely. The technology is designed for medium-to-large buildings, including residential ones.



La "ratio" della norma UNI EN 15232, ripresa anche dalla ISO 52120

Definition of the Smart Readiness Indicator (SRI)

What will truly represent a substantial change is the introduction of the Smart Readiness Indicator, or SRI. Introduced by Directive 844/2018, which updates EPBD 31/2010, it will be defined in Article 13 of the new recast of the EPBD currently in draft.

Le 3 funzionalità chiave dell'SRI, fonte EU

Annex 4 tells us that the **SRI** expresses:

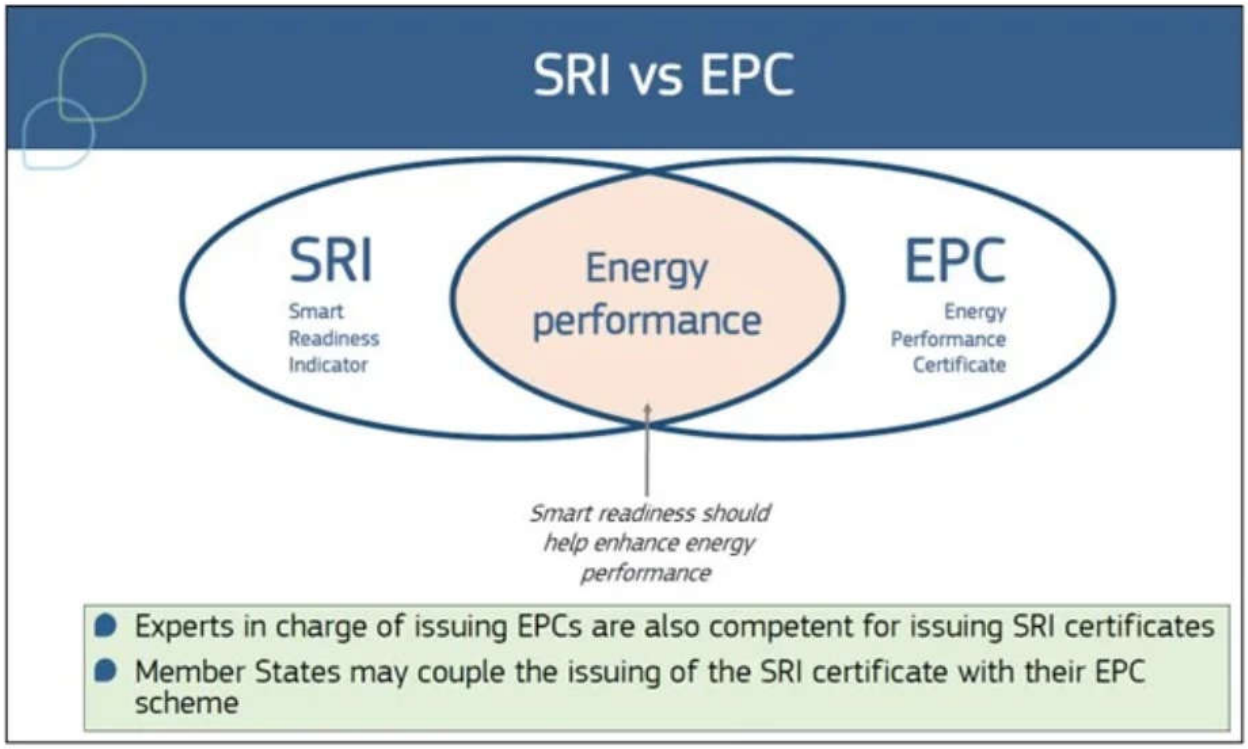
1. the ability to maintain the energy efficiency and functioning of the building by adapting energy consumption, for example by using energy from renewable sources;

2. the ability to adapt its operating mode in response to the needs of the occupant, paying due attention to ease of use, maintaining comfortable indoor climate conditions, and the ability to communicate data on energy use;

3. the flexibility of a building's overall electricity demand, including its ability to enable participation in active and passive demand management, as well as implicit and explicit demand management, in relation to the grid, for example through flexibility and load shifting capabilities.

The SRI therefore indicates the intelligence of a building, not in just 4 categories like ISO 52120-1, but with an index that goes from 0 to 100%, possibly grouped into 7 levels from A to G.

Europe would also like this method to be combined with the current APE in order to provide more complete information to all stakeholders of a building: owners, maintenance workers and above all occupants.



L'UE vorrebbe che l'SRI si affianchi all' APE (EPC sta per Energy Performance Certificate e non contract come spesso in Italia viene interpretato l'acronimo EPC). Fonte EU

Plant Report

1) premise

This report provides a technical and functional description of the home automation systems serving a condominium building used as a residence.

The plants affected by this report are the following:

- Condominium Building Automation System
- Home automation system in apartments

2) General characteristics

The building automation system must allow for the control and programming of the most common applications and functions, while also enabling remote maintenance and supervision, and the controlled management of incidents where possible. Specifically:

- Air Conditioning Management
- Energy Consumption Control
- Management of roller shutter and awning motors
- Remote Control via Multimedia Channels
- Home automation system redundancy to overcome accidental events
- Historical recording of main events on files
- Controlled remote maintenance
- Technical Alarms and Event Notifications
- UPS for the protection of electronic systems
- Building Automation based on local hardware-software solution
- Scheduled ordinary and extraordinary maintenance
- Hardware and software upgrade

The system as a whole must include customized automatic management of heating, domestic hot water production, or summer air conditioning systems, including their remote control via multimedia channels.

In compliance with the legislation, you must:

- display energy consumption through multimedia channels, by providing periodic data;

- show the current operating conditions and the set temperature of the systems;

- allow the systems to be turned on, off, and scheduled on a weekly basis remotely.

The work must be carried out in compliance with current national and local regulations regarding urban planning, construction, energy efficiency, and safety (systems, environment, and work).

3) Network infrastructure

The FTTH system will consist of the main rack/general building automation electrical panel located in the technical room on the terrace floor where the optical fiber will arrive from the operator.

From this rack, FTTH/POLan signals will be distributed to each individual apartment.

NB

The data network must be certified using instrumentation.

Also check that the IP rating of the electrical panel and data rack is suitable for the environment identified for installation.

This LAN-WiFi network connection will be dedicated exclusively to Building Automation and will not be available to individual condominium owners for private connections.

During the installation phase of the hot-spot module, check the Wi-Fi coverage of the apartment.

The information relating to the communication between the apartment control unit (located on the terrace floor) and the apartment will pass over the POLan network, on copper and/or fibre optic conductors.

The main connecting lines (risers) will pass through the existing cable ducts in appropriate conduits/channels.

Any cable connection is required in category cat 6 cat 6e.

Each apartment will receive a LAN cable to connect to the respective home automation panel. The panel will contain the relay boards for controlling heating heads and controlling the hot-cold fan coil functions, in a number adequate for the planned air conditioning zones.

The electrothermal heads are required to be of the 4-wire type (two rows for the opening/closing command and two for status information). A hot-spot LAN PoE device equipped with three RJ45 LAN outputs is provided near the panel, to be connected to a dedicated patch panel on the panel. Note: Very flexible patches must be used to connect the more sensitive LAN network devices.

All other field devices included in the project will use the Wi-Fi network generated by the hotspot device for in-out commands and notifications. Specifically, the room thermostats-humidistats, air quality control sensors, shutter and awning management modules, and apartment energy meter modules will be connected to the Wi-Fi network.

Verify that the power supply line to the home automation electrical panel of each individual apartment is protected upstream by a 30 mA differential circuit breaker. (Refer to the apartment's Building Automation panel diagram.)

4) Operating logic

The home automation solution involves installing a home automation control unit for each apartment in the building. This control unit will be installed in the building's home automation electrical panel, located in the shared room on the terrace. The control unit will be powered by 230V and connected to the internet via a dedicated network switch and subsequent modem router provided by the building operator via an RJ45 network cable. Equipped with a web-based interface, the control unit manages all the building's systems: air conditioning, shutters or awnings, environmental sensors, and interfaces with various devices. Remote control via a web interface must be possible from a personal computer or tablet running Windows, Linux, or Mac.

Any expansion of functions can be managed by adding additional devices upon request.

In apartments, Wi-Fi thermostats with touch displays equipped with temperature-humidity probes are used to control temperatures.

For the management and control of the condominium heating system, the use of a specific control unit with the following characteristics is envisaged.

- Control of air conditioning system flow temperatures and domestic hot water distribution using waterproof digital temperature probes.
- Alarm acquisition from heat pumps, chillers, air handling units, gas boilers, solar and photovoltaic panels.

- interface of all the machinery required for the air conditioning of the building:

  - modbus / GPIO / 0-10V interface for PDCs

  - Modbus interface for ventilation, Uta

  - NC-C-NO relay for the gas boiler

  - relay interface for power and fan control of the different split units

  - input from temperature and humidity sensors

  - input from waterproof temperature sensors for flow/return temperature control

5) Detailed operation of home automation control and energy monitoring

- ***Air Conditioning Management***
  The condominium has a centralized hot-cold system

A dedicated control unit for the heating plant will manage the heat pumps and gas boilers in the system using the necessary control interfaces. Additional temperature sensors in the storage tanks and on the system flow and return pipes will monitor the correct operation of heat production.
A control unit for each apartment will manage the heating heads in the various zones, the temperature and humidity data from the thermostats in the area, the air quality detected in the apartment, the open-closed status of shutters and awnings; and the user interface for programming and controlling the specific needs of each individual condominium owner.

- ***Energy Consumption Control***
  Energy consumption will be monitored directly at delivery points, condominium electrical panels, and apartment panels, using Wi-Fi energy meter modules to reduce the impact on masonry work. Appropriate historical files will be generated and archived for subsequent analysis and statistics.

- ***Management of roller shutter and awning motors***
  The shutters and awnings, which are moved and programmed based on solar radiation, wind speed, wind direction, and outside temperature (data collected by the weather station located on the building's terrace), will be controlled by dual-function relay modules with up and down control (99 selectable opening positions). The modules are back-mounted and Wi-Fi-enabled to minimize the impact on the masonry.

- ***Remote Control via Multimedia Channels***
  The Building Automation solution will have a standard web-oriented user interface and will be possible for remote control via a web interface from a personal computer, tablet, smartphone, or Windows, Linux, or Mac Smart TV. The customizable user access level includes both a high-level user for event planning, annual climate planning, and load control, and a low-level operator user who can switch on, off, and dim the various field devices.
  A 10”-12” inch tablet is provided for each apartment for local supervision.

- ***Home automation system redundancy to overcome accidental events***
  Two redundant home automation control units are provided, capable of replacing any faulty apartment control units without requiring technician intervention, and with the option of intervening after the fault has been resolved.
  Incident management plan based on the distribution of home automation programming at different levels with the aim of reducing the spread of potential errors to multiple parts of the system; in particular, the following is assessed:
    - *Apartment control unit error > solution: the backup control unit intervenes*
    - *Internet connection error > local system continues to work*
    - *Wifi connection error > all local wifi modules working with wall buttons*
    - *Power failures and voltage surges > Condominium UPS*
    - *Relay module error > replacement manual keypad*

- ***Historical recording of main events on files***
  The main events (temperatures, energy consumption) in the control center and in the apartments can be recorded on files for subsequent analysis and event logs

- ***Controlled remote maintenance***

Remotely manageable assistance and maintenance plan for immediate problem analysis and corrective interventions

- ***Technical Alarms and Event Notifications***
  Alarm collection plan and reports to one or more maintenance personnel involved depending on the type of fault or alarm encountered, alarm repetition in case of non-resolution

- ***UPS for the protection of electronic systems***
  Appropriate protection of all electronic components via a correctly sized and regularly maintained UPS;

- ***Building Automation based on local hardware-software solution***
  A hardware and software solution independent of external servers or clouds, ensuring operation even in the event of internet service failures, router failures, or remote server crashes. Furthermore, for added security, the control units for each apartment are independent of one another.

- ***Scheduled ordinary and extraordinary maintenance***
  The adopted Building Automation solution must be guaranteed by appropriate routine maintenance to ensure the proper functioning of all installed devices and, in the event of extraordinary interventions, the necessary and timely restoration operations through software and hardware interventions. These interventions will be performed on any hardware components that may become obsolete over the years or otherwise perform less well than new components released on the market.

- ***Hardware and software upgrade***
  Given the rapid evolution of all technology-based systems, it will be necessary to ensure the ability to update the Building Automation solution's hardware and software equally quickly. This eventuality, where possible, should also be managed at the request of individual condominium owners, independently of the rest of the building.