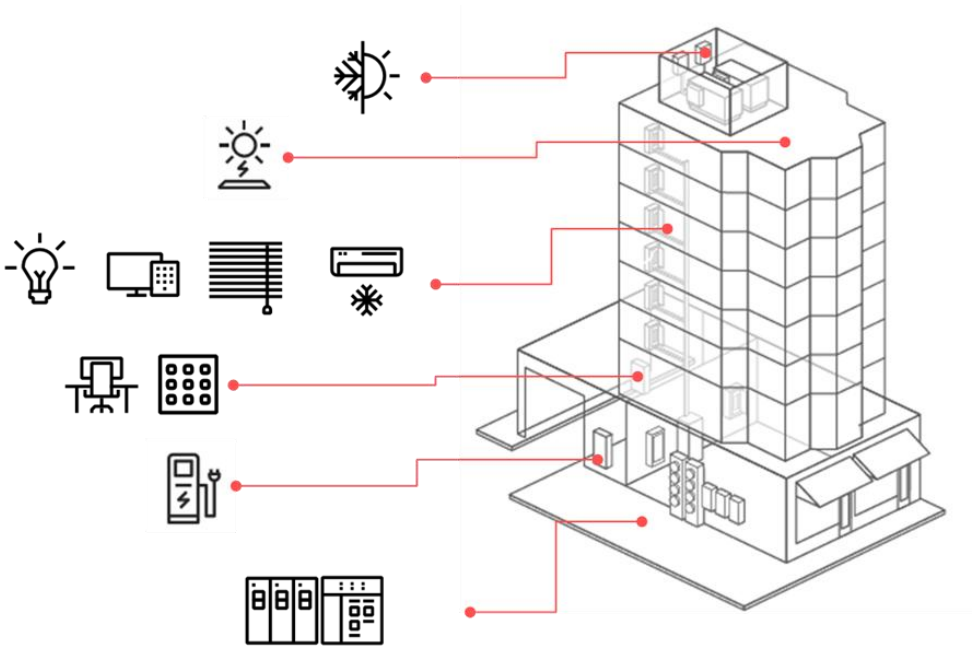
Chameleon+

Chameleon+ HaaS

HOTEL AUTOMATION SYSTEM TECHNICAL DESCRIPTION



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Hotel Automation

The purpose of hotel automation is to integrate modern technology into the construction and renovation of a unit, thus creating a space that is environmentally friendly and welcoming to the staff and guests.
The main failure encountered in the design of hotel automation is the inability to address the needs of all stakeholders.

Chameleon HaaS was designed with all stakeholders and their diverse needs in mind.
The owner/investor/operator is interested in a competitive advantage, low acquisition cost, support, a reliable branded solution, spare parts availability, low operating and maintenance costs, and energy savings.
Hotel staff need a simple, intuitive system that automates daily operations, providing oversight and control of the hotel.
The technical service department must have access to precise troubleshooting with a clear description of the fault and the ability to resolve it immediately.
The guests expect their stay to be a unique hospitality experience.

Chameleon HaaS derived by distilling the experience of more than 30,000 hotel rooms and is based on a decentralized architecture and open communication protocols, thus ensuring its reliability and maximum connectivity with third-party systems.
The system brings for the first time the most popular controller on the market, Siemens LOGO! , in the ecosystem of the leading automation protocol, KNX, as a cost-effective yet feature-rich guest room automation solution.
Siemens LOGO! was created in 1996 and is now in its ninth generation. It is by far the most popular and successful microcontroller (Smart relay) of the European market and is integrated into the KNX protocol through a gateway.
The KNX protocol dates to 1990 and under its umbrella are more than 500 manufacturers worldwide. KNX devices from different manufacturers are compatible with each other and can work in the same installation.
The choice of the above materials guarantees a reliable solution, which is also future-proof, expandable and has available service and spare parts through the life cycle of the hotel unit.

Chameleon HaaS provides control of all room loads and heating-ventilation-air conditioning/HVAC (comfort and energy saving scenarios). The system can be programmed to function with any KNX device with bidirectional communication, posing no limits on the GRMS implementation. The system's decentralized architecture ensures that all room functions are autonomous and the loss of a LOGO! controller is equivalent to the loss of only one room. A Modbus only mode is also available for more price sensitive applications.

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Guest room automation

Chameleon HaaS guest room automation system controls lighting circuits, curtains, power sockets, HVAC, (and every KNX application in general) in addition to guest presence monitoring. Reliable occupancy detection is the core of the solution and leads to maximum energy savings for the hotel.

Occupancy detection

In most hotel units, the common practice for monitoring guest presence inside a room is implemented with a card holder. When a guest enters the room, he must insert a card into the room card holder to turn on the lights and HVAC and be able to control them (“Welcome Guest” scene). Likewise, when a guest leaves the room and removes the card from the card holder, the lights and HVAC turn off with a small-time delay (“Guest Out” scene). This approach can easily be bypassed by the guest, leading to huge energy waste for the hotel.

Chameleon+ HaaS overcomes this disadvantage by not employing a card holder. Instead, occupancy monitoring is based on a sophisticated presence detection algorithm with a magnetic contact on the door and a conventional presence detector in each room. [Card Holders nevertheless are supported, even with two relay outputs to differentiate for Guest and Staff entry.]

The detection of entrance door opening triggers the start of presence detection algorithm, for a specified time. If movement/presence is detected within this time interval, the system sets the state of the room to “Occupied” and stops presence monitoring, avoiding any false presence/absence detections while the guest is in the room. When the entrance door closes, the system will start monitoring guest presence again. If no movement/presence is detected within this time interval, the system sets the state of the room to “Vacant” and activates energy saving scenes. The presence control algorithm also has a failsafe for the case of erroneously estimating the absence of a guest from the room. If movement is detected in an "empty" room, the algorithm will put the room in "Occupied" state, without changing the state of the lighting in the room ("Welcome Guest" scene is not activated).

When a guest enters or leaves the room, the following action occur:

Entering the room

- When the guest enters the room, the scene “Welcome Guest” is activated, which set specific loads to different states, sends “comfort” mode to the air condition unit (e.g. 26 °C if heating mode, 21 °C if cooling mode and fan speed to auto) and activates power sockets.
- If the room is in occupied state, **no scene is activated** when a guest enters the room, avoiding discomfort of occupants that are already inside the room(e.g. someone is sleeping)

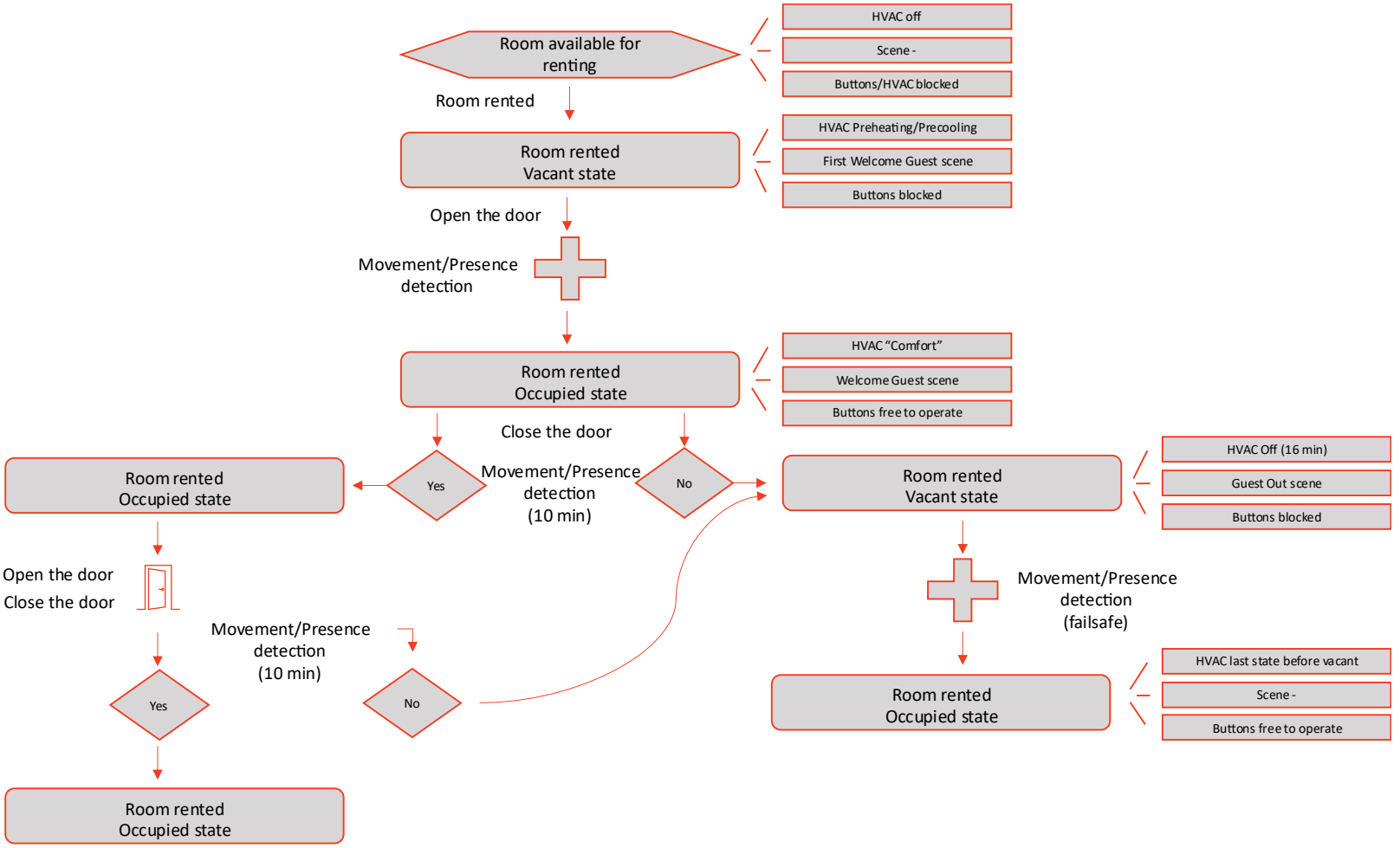
Leaving the room

- When the guest leaves the room, the scene “Guest out” is activated, which typically deactivates all loads, sends “standby” mode to the air condition unit and after a specified time, it switches it off. The power socket line is also turned off.

Connection to PMS

- **Chameleon+ HaaS** has the embedded capacity to connect with over 130 different PMS, receiving a rented or unrented information. This allows setting an extra “Guest Away” scene upon customer egress form an unrented room. “Guest Away” scene is also activated upon receiving an unrented signal from the PMS.

At reception level, **Chameleon+** exposes all bidirectional objects to KNX and Modbus protocols, ready to be incorporated into a visualization. In a full implementation where KNX protocol is implemented, Modbus protocol can be implemented as a hot redundancy in case of KNX failure (device or network).


Room available for renting
HVAC off
Scene -
Buttons/HVAC blocked
Room rented
Room rented Vacant state
HVAC Preheating/Precooling
First Welcome Guest scene
Buttons blocked
Open the door
Movement/Presence detection
Room rented Occupied state
HVAC "Comfort"
Welcome Guest scene
Buttons free to operate
Close the door
Yes
Movement/Presence detection (10 min)
No
Room rented Occupied state
Room rented Vacant state
HVAC Off (16 min)
Guest Out scene
Buttons blocked
Open the door
Close the door
Movement/Presence detection (failsafe)
Movement/Presence detection (10 min)
Yes
No
Room rented Occupied state
HVAC last state before vacant
Scene -
Buttons free to operate
Room rented Occupied state

Switches / Buttons

The system assumes conventional push buttons for the control of lighting and scenes by the guest. This design implementation offers:

- Reduced initial investment cost
- Low cost of ownership, since the expensive electronic units that make up the system are not exposed to wear due to usage by the guest
- Increased security by denying physical access to system components. Only authorized personnel have access to the consumer unit and false roof of the room
- Minimizing the single points of failure that lead the system to malfunction
- Increased reliability for functions that are perceived by the guest – Front of House (FoH)
- Reduced system downtime, since in the event of a possible failure, it is easier to identify, isolate and repair the issue (Mean Time to Discover, Mean Time to Isolate, Mean Time to Repair)
- Minimum number of system components, which facilitates maintenance and service and reduces cost of topology components
- Compatible with any design and brand of conventional push buttons, allowing freedom of choice for the architect and owner, in regards with aesthetic design or total cost of materials
- Renovating the guest room and replacement of switch range does not require reprogramming or additional costs

It should be noted that the implementation with conventional push buttons **does not have** a technical disadvantage compared to the classic implementation with electronic/system switches. Any conventional push button can be programmed to control lighting, HVAC, scenes and other functions we need.
The push buttons can either control individual lighting circuits (e.g. foyer light, WC light) or activate a scene where it is possible to control more than one lighting circuit. As an example, the push button beside the bed can activate a “Night” scene where the guest can turn all the lights off. If required the system can also incorporate KNX push buttons either exclusively or in a hybrid configuration.

Chameleon HaaS offers three types of different scene function:

Default Scene (one scene):

The classic implementation of a scene, as we find it in KNX. Every time we press the push button, the scene is activated and sends a command to multiple loads. Pressing it again will incur no further changes.

Bright/Dark Scene (two scenes):

This option allows for one push button to send two different scenes, based on measured brightness (requires external brightness sensor when ordering Chameleon). As an example, scene “TV” should close all the lights that reflect on the TV and turn on the ambient lighting, if there is not sufficient lighting. In this case, if we press push button “TV” and the room is dark, ambient lighting will turn on and some lights will turn off. If it is in the morning and the room is bright, ambient lighting will remain turned off when we press “TV” scene. Implementing Bright/dark scenes can lead to energy savings and comfort for the guest, since we make sure an adequate level of lighting is turned on without needlessly wasting energy.

Toggle Scene (two scenes):

This option allows for one push button to send two different scenes. The first time the button is pressed it will activate scene number 1. The second time we press it, it will activate scene number 2 etc. A typical use for this option can be the scene “Night”. We can make the push button “Night” a toggle scene, in which case the first time we press it, it will turn all the lights off. The second time we press it, it will turn on a night light or the bathroom light. A third press will turn all the lights off again.

In addition to the scenes controlled by the push buttons, various ingress and egress scenes are automatically configured as per design choices (see table below).

Presence Detectors	PMS	Cardholder	Cardholder 2 outputs		Scene/Description			
PD					**Welcome Guest**	**Guest Out**	**Occupancy failsafe**	
					Scene when guest enters vacant room	Scene when room becomes vacant	Motion is detected in a vacant room	
					Scene 1	Scene 2	Scene 64	
PD	PMS				**Welcome Guest**	**Guest Out**	**Guest Away**	**Occupancy failsafe**
					Scene when guest enters vacant room	Scene when room becomes vacant	Scene when unrented room becomes vacant/room becomes unrented	Motion is detected in a vacant room
					Scene 1	Scene 2	Scene 63	Scene 64
		CH			**Welcome Guest**	**Guest Out**		
					Scene when guest enters vacant room	Scene when room becomes vacant		
					Scene 1	Scene 2		
	PMS	CH			**Welcome Guest**	**Guest Out**	**Guest Away**	
					Scene when guest enters vacant room	Scene when room becomes vacant	Scene when unrented room becomes vacant/room becomes unrented	
					Scene 1	Scene 2	Scene 63	
			CH 2out		**Welcome Guest**	**Welcome Staff**	**Guest Out**	
					Scene when guest enters vacant room	Scene when staff enters vacant room	Scene when room becomes vacant	
					Scene 1	Scene 62	Scene 2	
	PMS		CH 2out		**Welcome Guest**	**Welcome Staff**	**Guest Out**	**Guest Away**
					Scene when guest enters vacant room	Scene when staff enters vacant room	Scene when room becomes vacant	Scene when unrented room becomes vacant/room becomes unrented
					Scene 1	Scene 62	Scene 2	Scene 63

HVAC Control

A great percentage of a hotel unit's energy consumption during its lifecycle is due to heating, ventilation and air conditioning (HVAC). Most studies have shown that this percentage amounts to 40% of total electricity consumption of a hotel. Integrating HVAC with the hotel automation system and implementing control strategies, allows maximum energy savings during the operation of the unit and brings a significant improvement in the reduction of operating costs, while contributing to the creation of comfortable conditions for the guest.

The guest room automation system integrates HVAC control with all options available in KNX. All types of HVAC systems can be integrated like AC split units and VRV/VRF systems (point to point and multipoint implementation), FCU, underfloor heating, radiators, etc.

HVAC integration in any case is adhering to the autonomous room principle. In the case of a multipoint VRV/VRF implementation the HVAC manufacturer's digital thermostat is employed, minimizing way the required automation devices, reducing total cost per room and complexity of the system. By keeping the factory thermostat, any fault that might occur in the gateway device is not perceived by the guest and the room air conditioning remains operational, ensuring guest comfort until the technical issue is resolved.

Room HVAC control is integrated with occupancy detection algorithm of the system, sending different temperature setpoints based on room state, to achieve maximum energy savings. Depending on the configuration of the system, various ingress and egress scenes are createdfor the variable states of the room. Each scene can be assigned with a different state for the HVAC, leading to advanced energy management.

Balcony door magnetic contact

The information from the magnetic contact of the balcony door will control the room's HVAC system, deactivating its operation if the window has remained open for a specific period (e.g. 8 minutes). Closing the window / balcony door will restore HVAC operation to its last state.
In case the balcony door has the capability of retraction, it is recommended to place the magnetic contact at the bottom so that the operation of the air conditioning is not interrupted when it is retracted.

Special functions

Emergency cord

The guest room automation system integrates an emergency button/cord for the bathroom which will inform the reception, in case someone has an accident and pulls it. The alarm can only be deactivated by reception staff.

Housekeeping services (HMS)

Two buttons can be available in each room for housekeeping services, a "Make Up Room/MUR" button and a "Do Not Disturb/DND" button. Each of these buttons has a light indication when activated and they are interlocked with each other, so it is not possible for both to be activated simultaneously. A light indication on the outside of the room can be implemented, allowing hotel staff to easily view whether a room requires a service.

The reception is immediately informed from the visualization, when a housekeeping button is activated. A "secret" function is available in the MUR button and can be activated by pressing it for 5 seconds. When a room is free for renting, hotel cleaning staff can inform the reception that the room is cleaned and ready, by pressing the MUR button for 5 seconds. The reception can monitor this state in the visualization and only then can the room be rented to a customer, by performing a Guest check in operation.

Chameleon HaaS

Visualization

A visualization of a hotel automation system allows management and supervision of the various functions that are implemented to it, through a computer or smart device that has access to the installation's IP network.

Chameleon can be visualized on any multiprotocol visualization suite, which must be installed on the server of the hotel and will be connected through the IP network with the rest of the automation system.

System devices

In Chameleon HaaS each room has a LOGO! base module and an optional 24 [V] / 1.3 [A] DC power supply, installed in the consumer unit, at minimum. The base unit can be complemented by a LOGO! expansion module, a LOGO! DM16 24R expansion module or a LOGO! DM8 24R expansion module. So, available Input / Output configurations are 8/4, 12/8 or 16/12.
Room devices are complemented be all required KNX devices per project.
Occupancy detection requires one conventional presence detector in each space of the room (e.g. bedroom, bathroom).

Type	Description
LOGO! 12/24RCEO	LOGO! 24RCEO (AC), logic module
LOGO! DM (8)16 24R	LOGO! DM(8)16 24R expansion module
KNX devices	HVAC, lighting, shutter, Sensors, etc
LOGO! Power 24 V / 1.3 A	LOGO! Power 24 V / 1.3 A
0 489 41	PIR IP 20 ceiling-mounting motion sensor, 360°

A KNX/LOGO! gateway along with a 24 [V] / 0.6 [A] DC power supply is installed per 5 LOGO! base modules (5 rooms), in the consumer unit located in the common areas (typically in room floor corridor). If a Modbus only mode is selected, these devices are not required.

Type	Description
Weinzierl 716 secure	Modbus TCP gateway (secure)
LOGO! Power 24 V / 0.6 A	LOGO! Power 24 V / 0.6 A

Finally, the system is complemented by topology devices (KNX/IP routers and KNX power supplies) and all KNX devices required in the common areas.

Network and cabling

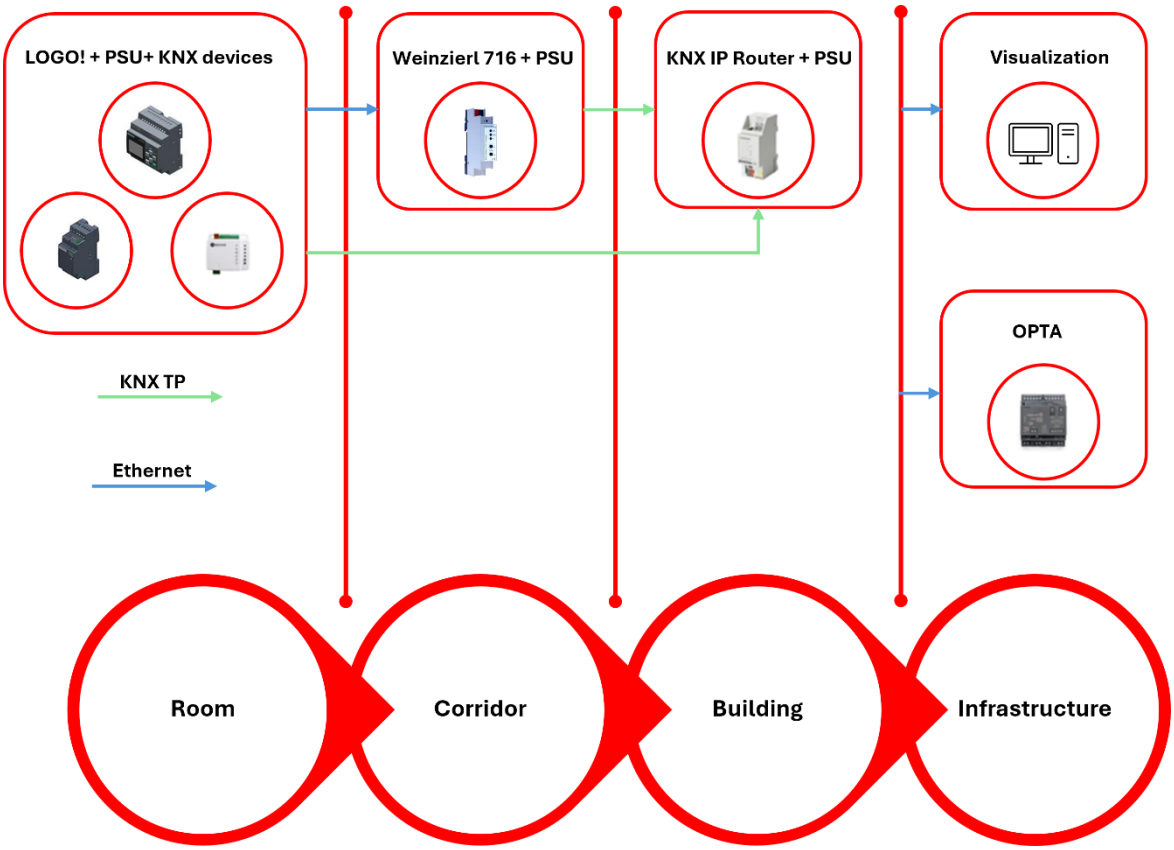
Chameleon HaaS is implemented on two types of networks.
The first network is KNX over twisted pair cable (TP) and must be routed to each room for the connection of all KNX devices, as well as to each Weinzierl 716 secure device in the common areas' consumer unit. The KNX TP cable will end up at KNX IP Routers and KNX power supplies (one or more) depending on the number of KNX lines defined.

The second type of network is Ethernet. This cabling is part of the hotel's structured cabling and is recommended to be implemented in a separate VLAN. Each LOGO! base module must be connected to the VLAN with the corresponding Weinzierl 716 secure gateways and KNX IP Router. Therefore, an ethernet cable must be routed to each room and to the KNX/IP routers in the consumer units of the common areas.

Topology

The below picture shows the system topology. In addition to the materials mentioned in the structured network (ethernet connection), the OPTA licensing device must be connected to the computer / server where the ComfortClick (or other) visualization will be installed.

Type	Description
Comfort Click Pro	bOS PRO License (2 users)
OPTA Lite + PSU	PLC for licensing of the project.



The design of the Chameleon HaaS system is based on the following principles:

Autonomous room

All room functions, such as occupancy detection, HVAC control, lighting control and scene activation (both “Guest in” and “Guest out”, as well as scenes from push buttons) are implemented on room devices (LOGO! and KNX devices).
Failure of one device is equivalent to the loss of only one room, which even applies to the power supply of the devices.

Differentiation between FoH and BoH functions

In guest room automation design, a careful separation between functions that are perceived by the guest (Front of House/FoH) and functions that are perceived by hotel staff (Back of House/BoH) is formulated.

The system ensures to the maximum extent possible, that there will be no failure in any function that is FoH, as the customer experience directly depends on them. A failure in BoH operation should be avoided but does not affect the customer's stay.

FoH functions

- Local control of AC unit, lighting and scene activation
- Occupancy detection and scene activation based on room state (Welcome Guest, Guest Out, etc)
- Turning the HVAC unit on or off, when a guest enters or leaves the room

BoH functions

- Automatic pre-cooling/pre-heating of the room when a guest is checked in
- Gradually turning off the HVAC unit (26 minutes cycle)
- Balcony door functionality

Minimize Single Points of Failure

We define a Single Point of Failure as a point which can disrupt system operation as a whole, or a big part of it. In Chameleon HaaS system, all the necessary devices for room operation are part of the guest room automation system and are installed in the consumer unit of the room. If a KNX device is used inside the room, the connection is implemented through Weinzierl 716 secure, which assumes the communication for five rooms. This, however, does not constitute as a Single Point of Failure, because Weinzierl 716 health is actively monitored. In case of failure, a failsafe can be activated action to ensure normal execution of every Front of House function through Modbus protocol (hot redundancy).

Minimize mean down time

The time to repair a system malfunction can be divided in three stages, all of which can be added to give us the total time to repair the failure

- **MTTD** (Mean Time To Discover a failure) is defined as the time required to discover the existence of a failure. In the case of Chameleon HaaS, this time is zero since all system devices are monitored for faults in real time.
- **MTTI** (Mean Time To Identify a failure) is defined as the time required to recognize the existence of a failure. This time is also zero since a notification will inform the hotel staff for unit failures of all LOGO! and KNX devices
- **MTTR** (Mean Time To Repair a failure) is defined as the time required to repair the failure. In the case of a FoH failure, this time is very short and does require the involvement of the system integrator. The program of LOGO! is stored on an SD card. In case of failure, a new LOGO! unit is wired from the hotel's maintenance team and the new LOGO! can be fully programmed by inserting the SD card and resetting the voltage.

Low Total Cost of Ownership

The total cost for a hotel automation system comprises of the initial investment cost and the cost of operation/maintenance during the unit's lice cycle.

Chameleon HaaS has a low initial investment cost compared to other KNX implementations, because:

- The heart of the system is the LOGO! base module which allows for a powerful implementation with extensive functionality and is cost effective compared to a classic KNX system design
- Occupancy detection algorithm is implemented entirely inside LOGO! base module, allowing use of conventional presence detectors instead of KNX system devices, which are more expensive and more difficult for maintenance and system management
- It uses conventional push button switches instead of KNX switches which have an increased cost of ownership. It is worth noting that the use of conventional switches offers freedom in choosing the design of the switch, according to the preferences of the architect and the owner and disconnects the offered functionality of the system from the aesthetic choice of the switch material.

Chameleon HaaS offers low cost of operation and maintenance because:

- The electronic units that make it up are not exposed to wear and tear due to use by the visitor
- Minimization of the number of electronic units that make up the automation system, which reduces the cost of peripheral components for the system topology
- Fault recovery for LOGO ! modules , switches and monitors require no additional maintenance costs for their reprogramming and commissioning
- Siemens LOGO! programs run on any consecutive model, so the program is guaranteed to run on which ever LOGO! module is in production at the moment of the failure. No expensive hardware replacement or reprogramming is required.