automated

Design Guide

RAPIX
LIGHTING
CONTROL SYSTEM

Version 1.1 - December 2016

DIGINET
CONTROL SYSTEMS

GERARD
LIGHTING

DALI

DALI Xi
EXTENDED INTELLIGENCE

Introduction

The RAPIX Lighting Control System represents the cutting edge of lighting control systems for commercial spaces and is founded on the International Standard for Lighting Control, DALI (IEC 62386).

The RAPIX Lighting Control System design compliments the standard and removes hardware requirements and system layers through native Ethernet command transportation, ensuring things happen quickly, securely and is ready for the future.

We have started with a clean technology slate and released our team from old fashioned, last century lighting control paradigms. Instead we have focused on security, LED performance and open systems in a world rapidly converging into IT and I.O.T (Internet of Things)

Ideally a Lighting System will comprise of a range of components which are tested to a standard and proven to operate to a minimum performance level to achieve the desired result. This includes drivers, ballasts, wall switches, sensors and lighting controllers.

When all these pieces come together we call it a Lighting System.

The **Practical Application Notes** and **Control Methods** we have detailed in this **Design Guide** will enable you to implement best practice Lighting Systems for a range of common applications in commercial spaces and help you meet your customer's needs of:

1. energy compliance and associated costs savings
2. occupant comfort and productivity
3. system security
4. adherence to international standards
5. use of innovative product for future proof projects

Whilst there is a focus on commercial office buildings in this Design Guide, the RAPIX Lighting Control System is suitable for a wide range of commercial lighting control applications.

Companion documents

This Design Guide is best read in conjunction with the RAPIX Lighting Control System Engineers Specification. However it has been written and presented so that a full understanding is possible without cross referencing the specification.

It can be downloaded here: http://www.diginet.net.au/go/getspecification/

Copyright and fair use

Whilst Gerard Lighting Pty Ltd retains all copyright in this material, use of this document is granted freely to Engineers and Lighting Designers when specifying the RAPIX Lighting Control System into your projects.

Support

If you should require any further assistance in preparation of your specification we are here to help. You are welcome to contact us directly or any of our RAPIX Xi Certified Systems Integrators:

http://www.diginet.net.au/rapix/rapix-xi-certified-systems-integrators/

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RAPIX Lighting Control System Product List

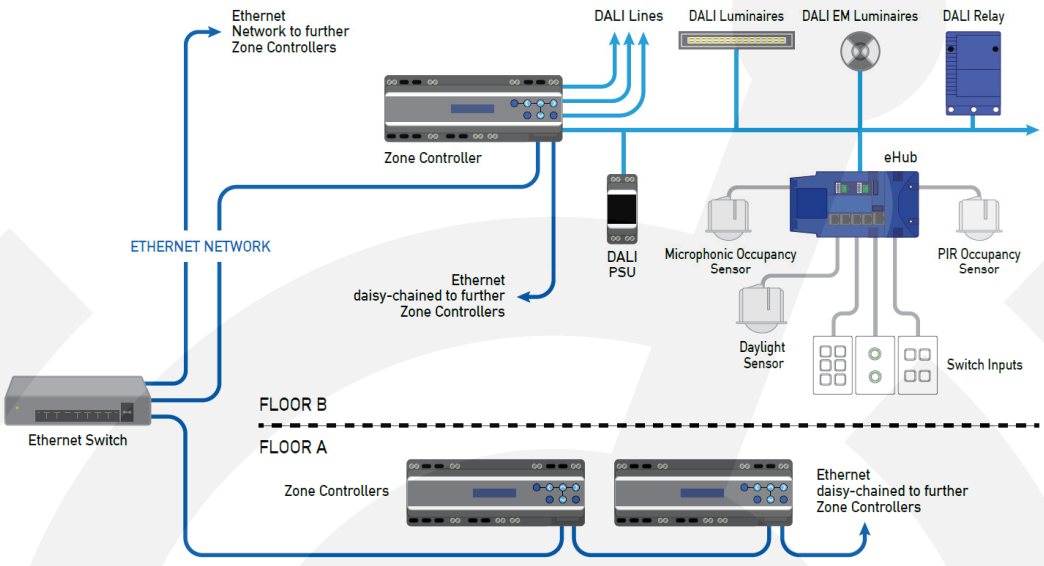
With this small collection of products, designing simple yet sophisticated lighting control systems to meet the energy and comfort needs of your clients is simpler, faster and easier.

Product	Description
RAPIX zone controller DGOZ-ZONEC-4DA 	The RAPIX Zone Controller is an embedded Ethernet/DALI controller that supports seamless joining of individual DALI Lines in a building. Each Zone Controller can connect up to four physical DALI Lines and communicate over an Ethernet network to lines on other Zone Controllers. The controller software allows DALI devices and DALI Groups across any DALI Line to be linked together to form DALI Xi 'Zones' and 'Scenes' to suit the application. **This capability saves Design Time, Installation Time and Commissioning Time.**
RAPIX eHub DGOZ-EHUB-4G-2S 	The eHub manages input peripheral power requirements, as well as embedded logical functions and DALI communications. The connected input peripherals, such as RAPIX Modular Switches and PIR occupancy sensors, are then able to communicate with a DALI Line. The eHub includes connections for four smart input peripherals, and two additional input connections for occupancy sensors and/or dry contacts (for security system input, for example). Up to 24 eHubs can be connected to a single DALI Line, with each eHub drawing only 2mA from the DALI Line.
DALI Relay Device DGOZ-RLY-10A-01 DGOZ-RLY-10A-02 	The one channel and two channel DALI Relay Devices are capable of switching up to 10 Amps of LED, fluorescent, incandescent and HID lighting loads via DALI commands issued on a connected DALI Line, making it suitable for a wide range of commercial and industrial building applications. These are 100% DALI compliant relays thus introduce NON DALI devices to be controlled by the RAPIX Lighting Control System.
DALI Phase Dimmer DGOZ-DM-400W-0 	The Diginet DALI Adaptive Phase Angle Dimming Device is designed for dimming up to 400W of connected lighting via DALI commands issued on a connected DALI line. The device includes a large area for terminating all 1.5mm2 or 2.5mm2 double insulated cables(240Vac Active supply cable, switched load cable and DALI Line cables). The device is fully tested to and complies with DALI standards IEC 62386.
RAPIX PIR occupancy sensor DGEMS360CL 	This High Definition PIR Occupant Sensor is connected to a RAPIX eHub. The sensor includes a detection lens which senses both Minor and Major Movement (as defined by NEMA Standard WD 7 – 2011 for Occupancy Motion Sensors). Presence is detected via a sensor array with **864 fields of view, ensuring reliable operation to a distance of 7m diameter**. The device also includes a light sensor for detecting ambient light levels.

Product	Description
Dual technology sensor **CM-PDT-9-AU** 	This **Dual Technology Occupancy Sensor** with Passive Dual Technology (PDT) first detects motion using Passive Infrared (PIR) detection and then engages Microphonics™ to hear sounds that indicate continued occupancy. This 360° occupancy sensor provides line-of-sight PIR detection of small motion in a circular pattern, and combines overlapping Microphonics™ coverage for detection of occupants working in cubical spaces.
Modular push button switches **DGOZ-MOSW-M-PB** **DGOZ-MOSW-S-PB** 	These modular switches fit in standard Australian wall plate apertures. The switches are available as 'Master' and 'Slave' mechanisms. Master switches connect to a RAPIX eHub and each Master is capable of being connected to five Slave switches. Switches can be configured in RAPIX software to perform a wide range of functions and each module (Masters and Slaves) includes two software configurable LED indicator colours, white and warm white.
Modular rotary switch **DGOZ-MOSW-M-RE** **DGOZ-MOSW-S-RE** 	The Modular Rotary Switch has all the functionality of the modular switches to provide manual control of the connected lighting. The simple rotary interface, interchangeable large and small dial and coloured rings, provide a simple and powerful interface to control lighting simply.
Light Level Sensor **DGOZ-LLS-M** 	The Light Level Sensor can be used as part of a RAPIX Lighting Control System to control a space based on ambient light measurement. The RAPIX Light Level Sensor connects directly to an eHub and is used to measure light levels in a space and send this information to the eHub for logic processing. Up to three RAPIX PIR occupancy sensors can optionally be directly connected to the light level sensor.
Multiplexor for Occupancy Sensors **DGOZ-MPX-PIR3** 	The Multiplexor is used as part of a RAPIX Lighting Control System to allow each of the four smart ports on an eHub to control up multiple occupancy sensors. The RAPIX Multiplexor connects directly to an eHub and up to three occupancy sensors can be directly connected to each Multiplexor. Expands eHub smart ports to allow three occupancy sensors to be connected to each of the four ports (12 in total)
DALI power supply **DGLMPS01** 	A single line, fully DALI compliant power supply. Each DALI Line in an installation requires a dedicated DALI power supply for correct operation of the DALI system. 100% DALI compliant.

Visit http://www.diginet.net.au/rapix/rapix-system-details/ for product data sheets, installation manuals and more.

Typical system architecture



Typical Multi-floor system topology

RAPIX Zones and Zoning explained

The RAPIX Lighting Control System utilises DALI control hardware which is fully compliant with the DALI standard. In addition, the RAPIX Lighting Control System has implemented an advanced feature set called 'Xi' or 'Extended Intelligence'.

With Xi comes a unique concept of Zones.

First, a DALI system is configured according to the DALI standard. We recommend using RAPIX Addressing to do this. (http://www.diginet.net.au/rapix-addressing/)

What is DALI?

In simple terms a DALI Line (a.k.a a 'DALI universe') contains:

- Up to 64 DALI devices
- Each of which can be individually addressed through a DALI Short Address
- Each DALI Line can have up to 16 Groups of control
- Each DALI Short Addressed Device can be a member of 1 or more Groups (maximum 16)
- Each DALI Short Addressed Device can have up to 16 DALI Scenes.

All of this Short Address, Group and Scene information is stored directly in the DALI device providing distributed intelligence, digital ceiling.

DALI commands are issued onto the DALI Line in a number of ways that communicate to either a DALI Short Address or a DALI Group Address to recall and re-produce the lighting scenes and lighting effects as required.

However, each DALI Line is separate from every other DALI Line meaning that cross DALI Line communication has been challenging in the past.

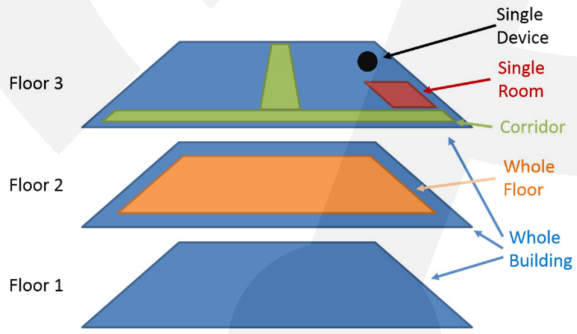
Imagine a large open office space with multiple DALI Lines, where some DALI devices from one Line and some from another Line are needed to be included in the same area of control.

This type of DALI cross Line communication, keeping track of what is where and in what Group with what Scene information, and duplicating this understanding across a building wide infrastructure, introduces significant system and management overhead and significant maintenance concerns in the future.

Introducing zones

Zones and the commissioning act of zoning luminaires/lights/lighting fixture/devices describes the allocation of individual DALI devices or DALI Groups into mixed lighting control zones.

Creation of zones allows the RAPIX Lighting Control System to interact with that zone in a number of ways beyond what is required by the DALI standard. This Zone method creates a primary abstract control layer.



THE SYSTEM CAN THEN BE SIMPLY DESIGNED AT ANY SCALE AND PROVIDE CONTROL GRANULARITY NO MATTER WHERE A DALI ZONE CONTROLLER OR DALI DEVICE IS LOCATED – EFFECTIVLEY REMOVING SYSTEM DESIGN AND COMMISSIONING COMPLEXITY.

Key benefits of RAPIX Zones

Feature	Benefit
Makes DALI simpler, more scalable	By understanding the basic principles of DALI, consultants and contractors can create Lighting systems of any size, install them easily and commission them faster.
Remove DALI limitations remain DALI compliant	Breaks free of DALI fade rates, Group and Scene limitations whilst providing full compliance to the base standard in every way, ensuring future interoperability.
DALI cross line communication	Save time during design, redesign and site installation. It no longer matters which Zone Controller or DALI Line the DALI device is physically attached to. Combining DALI devices from separate DALI Lines or separate Zone Controllers into a cohesive lighting scene is simple and straightforward, saving time and money.
Eliminate design constraints by unlimited zones	Consultants and contractors do not have to be concerned with exceeding the systems capabilities. Once they understand DALI they can design any system of any size.
DALI compliant	All RAPIX Lighting Control System products are DALI Compliant and branded with the official DALI logo as confirmation of this compliance.
Future proof	Zones enable the simple and fast reconfiguration of any RAPIX Lighting Control System at any time in the future.

Single DALI Line systems AND Multiple DALI Lines systems

The RAPIX Lighting Control System offer designers the ability to provide sophisticated lighting control on a single DALI Line and/or across multiple DALI Lines.

A fully featured single DALI Line system is achieved simply using a DALI Power supply (DGLMPS01) and 1 or more DALI eHub devices (DGOZ-EHUB-4G-2S), sensors and modular switches.

These single DALI Line solutions provide sophisticated control to a single office, a boardroom or multiple offices and provide full DALI compliant performance.

With the inclusion of RAPIX Xi technology in every eHub, designers are provided access to extended fade rates, more groups and more scenes for when DALI can't provide all the functionality required to achieve the design requirements.

Building Wide Scalability

For building wide scalable lighting control solutions the RAPIX Zone Controller provides cross DALI Line/cross Zone Controller communication over Ethernet simply and easily. With the addition of the DALI eHubs installed directly on the DALI Lines, connecting the sensors and modular switch peripherals extends functionality and sophistication.

Introduction to intelligent office solutions

Reducing the ongoing operating costs whilst maintaining occupant productivity and comfort is one of the most significant challenges for commercial building owners, tenants and facility managers.

Intelligent office solutions offer these stakeholders significant opportunities to enhance efficiency, increase productivity and provide the best quality of light - only when light is needed - to amplify energy savings.

An intelligent Lighting System Solution from RAPIX delivers on the promises of bottom line savings associated with energy costs whilst meeting optimal occupant comfort needs.

The RAPIX Lighting Control System empowers individual occupants to interact with the lighting in their environment to create a mood which will maximise their productivity and comfort whilst ensuring the facility's underlying energy efficiency demands are met, particularly when coupled with good quality lighting and lighting design.

The RAPIX Lighting Control System acts automatically to provide light only when light is needed, trimming lighting levels according to natural light ingress into the commercial space and attending to the ebb and flow of the day in the life of an office.

Importantly RAPIX enables facility managers, tenants and builders owners to make future changes to the space, removing high costs associated with re-wiring and re-commissioning.

Key Benefits of Creating Intelligent Offices

Function	Benefit
Provides Compliance Points to National and Global Energy Standards	Intelligent offices using intelligent lighting control methods contribute valuable points to help buildings achieve compliance to standards such as NCC/BCA Section J, GREEN STAR, NABERS, LEED, BREAM.
Increases Property's Rent-ability	Higher NABERS rated buildings enjoy reduced vacancy, reduced outgoings, reduced incentives and reduced yields*.
Adds Property Value	According to NABERS a 5 star NABERS energy rating delivers a 9% green premium in Property Value.*
Automates Repetitive Functions	Lowering the dependence on human interaction to achieve repetitive tasks removes risks and increases energy savings through guaranteed execution on time every time.
Inspire Energy Efficiency	Data collected from Intelligent offices can be visualized and communicated to occupants to encourage further activities which in turn add to further energy savings and a sense of wellbeing.
Promotes Productivity	Intelligent offices automatically adjust lighting which has been designed to affect people's moods and therefore the quality and quantity of effort expended, affecting the bottom line of organisation's most costly and valuable asset.
Minimise Operating Costs	By providing light only when lights is needed, operating costs are minimized automatically and can be tuned further by diagnosing the intelligent offices' systems and utilising floor space more effectively.

Function	Benefit
Minimise Maintenance Costs	Intelligent offices provide control of energy efficient lighting, effectively. With a reduction in energy comes a reduction in component stress and allows for scheduled maintenance cycles allowing facilities to leverage economies of scale in purchasing and have less downtime, unscheduled or ad-hoc maintenance.
Task Tuning	Increases occupant satisfaction and productivity by providing control of lighting where and when they want it, whilst maintaining core energy management goals.
Future Proof	Intelligent office systems consists of intelligent sensors and controllers which can be easily re-programmed to perform different functions and provide adherence to design needs and compliance requirements without wholesale replacement of system components.
Simple Integration	By enabling systems to easily communicate with each other an intelligent office can easily communicate to and from connected systems such as HVAC, Audio Visual and other Building Management Systems, removing complexity, overhead and minimizing human involvement.
IOT Ready – Internet of Things	Intelligent offices collect and share data with other systems, some of which will be connected to the Internet. Machines communicating with machines without any human interaction, often over the internet, can ensure real time decisions can be made to improve the space and the provide the most value to the occupants, tenants, facility managers and property owners.
Safe and Secure	Modern day Intelligent offices provides occupants and facility managers security and peace of mind at all levels by using international standards and encrypted, authenticated communications to protect itself and the facility it is in control of.

*NABERS - Building better returns with NABERS - http://www.nabers.gov.au/public/WebPages/ContentStandard.aspx?module=10&template=3&include=ResearchStats.htm&side=factsheets.htm

Practical Application Notes

To provide clarity and understanding of how to best implement the RAPIX Lighting Control System in different types of applications we have detailed a number of Practical Applications and the best way to implement these using DALI and Zoning.

In the following 'Practical Application Notes' and 'Control Methods' sections, an understanding of the RAPIX Zoning concept is required as it significantly simplifies many system design processes and saves significant commissioning and re-commissioning times.

RAPIX delivers smart office solutions, simply

The modern commercial office space provides a plethora of opportunities for the RAPIX Lighting Control System to help save energy and reduce costs whilst enhancing the environment for the occupants.

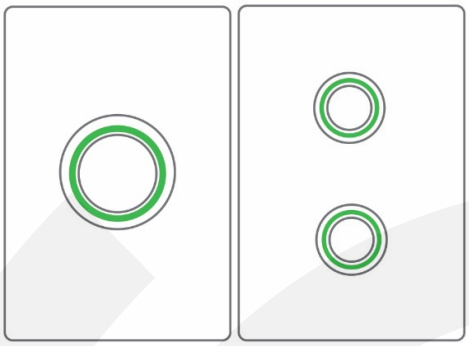
As there is a wide range of applications, these have been addressed individually in the following Practical Application Notes. This is a working document which will be updated with more practical Application Notes over time.

Note that these office scenarios are one commercial application are and does not encompass all scenarios, system capabilities or logic functions possible. However using a combination of the strategies herein you have the tools necessary to design for a multitude of commercial building lighting control applications.

Return of the rotary – simple lighting control

A rotary dial or 'potentiometer' – also known as a rotary pot – provides the simplest way to provide this easy to use 'lighting only' control.

The rotary dial is an interface that users understand due to its simplicity, but the rotary pot of old is gone and has been replaced with a Digital Rotary Dimmer opening a world of new lighting control possibilities.



RAPIX Lighting Control Digital Rotary Switches provide excellent dimming performance of DALI luminaires, with a smooth dimming action and tactile feedback to let the user know what is happening.

Digital Rotary dials also spin freely in both directions and come complete with an on/off press and press-to-dim mechanisms to expand on the possible control scenarios.

A RAPIX digital rotary dial can be assigned to control any number of DALI luminaires, groups of luminaires or entire DALI Lines smoothly and simply.

Why Users Love the Rotary

1. Its simple. Users understand how a rotary dial operates
2. Its clear. There is no need to label the device
3. Its inexpensive. Full on /off and dimming capability from a single point on the wall removes the need for complex, multi-button lighting panels.

The RAPIX Lighting Control System features a sleek rotary dial interface allowing simple yet sophisticated lighting control functionality.

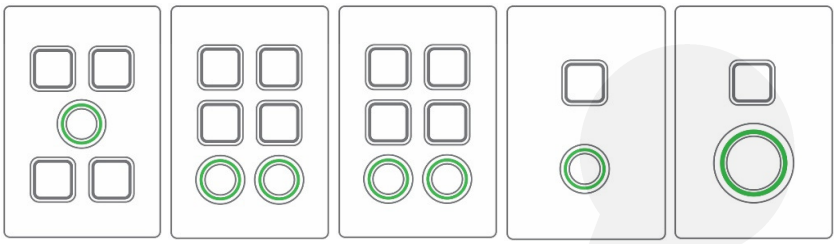
A RAPIX Rotary solution also provides:

- Smooth dimming from 0.1% to 100%
- Large and small dials in multiple colours to suit the panel aesthetics or to indicate master or minor operation.
- A range of coloured rubber rings which fit the different dial sizes for simple circuit or group identification

In this way the user can control their lighting intuitively, simply and inexpensively without sacrificing dimming performance or integration to other systems.

There is no need to provide engraving; the users are comfortable with the rotary interface; the rotary interface can be combined with push buttons and rockers too.

RAPIX Modular Switches - LED Backlight Operation



Wall switch - LED Backlight Operation

Whether you choose to use the Rotary, push button or rocker, all RAPIX Modular Switches feature the same LED backlight configuration properties. These intricate configuration properties provide designers choice to match décor, client's needs and to standardise how one would like their specified RAPIX Lighting Control System to always operate.

Each button can be configured on 3 variables to fine tune your design - colour, output level and timeout.

Colour

Each Master and Slave Modular Switch comes complete with a white LED backlight and an amber LED backlight. It is possible to configure these to operate differently in different states. Each button's backlights can be individually configured, operating separately for different states,

- On state
- Off state
- Inactive State

Output Level

It is also possible for the output level of the backlights to be configured for each of these state from 0% to 100%.

Timeout

Finally, it is also possible to configure inactive time-out periods when backlights transition from active to inactive.

For example, when a button is pressed the amber backlight LED is illuminated providing visual feedback to the user that the command has been received.

When the button is inactive and the lights in the room are on, the amber backlight is dimmed to 50% after 10 seconds of inactivity.

When the lights in the room are off, the white backlight is illuminated to 10% of its maximum output. This assists users to both locate the button and identify the current state.

The system is delivered with some standard sensible configurations of these variables to save time.

The RAPIX Lighting Control System also provides automatic state tracking to DALI Short Addresses and DALI Groups.

For example, if there are two RAPIX Modular Switches controlling a room, when a button is pressed on one RAPIX Modular Switch, the duplicate button on the sister switch mirrors this state change, providing intuitive user feedback.

Application Note - Boardroom

The modern boardroom is full of technology and an application where lighting control makes perfect sense. Controlling the lighting simply and effectively on room-entry remains the base performance expectation today. This is preferred over complicated controls with multiple buttons.

Figure B1: Typical Boardroom Layout

In many cases the boardroom can be treated as a separate lighting control area. That is, whilst comprehensive lighting control may not be required in the open office spaces, the boardroom can have a RAPIX Lighting Control System installed with a full feature set and capability simply and inexpensively.

In this way the boardroom can receive the full lighting control treatment, even if the rest of the office does not require it. A single DALI Line can easily service 1 or more boardrooms and using RAPIX Lighting Control, provide sophisticated but simple control using the RAPIX Lighting Control Xi (Extended Intelligence) technology.

Common Control Requirements for Boardrooms

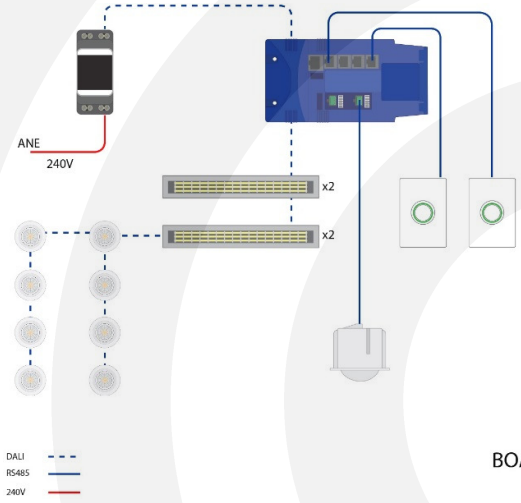
1. Turn the lights on+off+task tune easily – either manually or automatically
2. Control the lights for everyday meetings and presentations
3. Have the flexibility to fine tune the lighting scenes to the exact meeting type and be sensitive to attendees
4. Comply to building codes for automatic energy savings

The boardroom in our example Figure B1 has 2 entries and hence having two wall switches, one at each entry location, makes sense for the user.

The controls buttons and rotary dials are duplicated on both wall switches so the user has the same control capability from either location. Additionally the boardroom has a PIR motion sensor, operating in vacancy mode for maximum energy savings.

Boardroom Example Equipment List:

Quantity	Product	Part #	Description
1	RAPIX DALI eHub	DGOZ-EHUB-4G-2S	DALI Line controller and RAPIX peripheral input device
1	DALI Power Supply	DGLMPS01	Supplies required DALI power to luminaires and eHub
1	360 PIR Sensor	DGEMS360CL	PIR with 864 fields of view motion/occupancy/vacancy sensor
2	Rotary Dials	DGOZ-MOSW-M-RO	Wall switch



BOARDROOM

The DALI PSU receives mains power protected by a suitable MCB upstream. The DALI Line is powered by the DALI PSU and the RAPIX eHub is connected to the same DALI Line as the DALI luminaires.

The Rotary dials and the PIR sensor are connected to the eHub. The user interacts with the system either manually via the Rotary Dials or automatically via the sensor.

The function of the sensor and the rotary dials is determined by their programming which is stored in the eHub.

Only the DALI power supply needs to be installed in an electrical enclosure as all other devices are SELV or DALI.

Day to Day Operation

On entering the boardroom a user can press the rotary dial to activate a lighting scene which controls all lights in the boardroom. Likewise, pressing the rotary dial again would turn the lighting off.

By using the rotary dial interface, dimming the lights up and down is as easy as rotating the dial in either direction - left or right for down and up dimming respectively. If the user prefers they can also press and hold the rotary to dim up and down.

If there was a desire to provide the user the ability to control different groups of lights to different levels or to create a scene this can be programmed to occur automatically from the rotary on press and designers could also specify a combination panel including rotary dials and push buttons for example.

In this boardroom it may be ideal to control the down lights and the suspended linear luminaires to different levels for different meeting types, such as using the projector during a power point presentation.

When the lights are turned on the sensor begins to operate – (known as vacancy operation) and when its programmed conditions are met – no motion detected for a 'period of time' – it will automatically dim the lights

to a dwell level, wait for a prescribed time and check for motion, and then ultimately dims the lights to off to save energy if no further motion is detected.

When exiting the room, the users can press the rotary to turn all lights off as they exit or simply exit and the sensor will do this automatically, in time.

If we were using scene buttons, and a presentation scene was selected, the system can be configured to disable the sensor when that scene is operational. Users don't want the sensor detecting motion and recalling an 'on' scene AND nor do they want the sensor to start its vacancy process and turn the lights in the board room off.

When any other scene is selected the PIR sensor will be operational again automatically..

Why Use Simple Wall Switching?

As the boardroom commonly has a range of other audio visual technologies, a touch screen, Apple iPad or Android tablet may be provided for integrated control all of these services, including lighting in an integrated way.

However forcing a user to access lighting control from a touch screen or tablet over complicates this requirement and a simple 'lighting only' interface is often a better choice. The tablet control can then be accessed as needed for integrated control, including lighting.

Sensor operation explained - Occupancy and Vacancy Operations

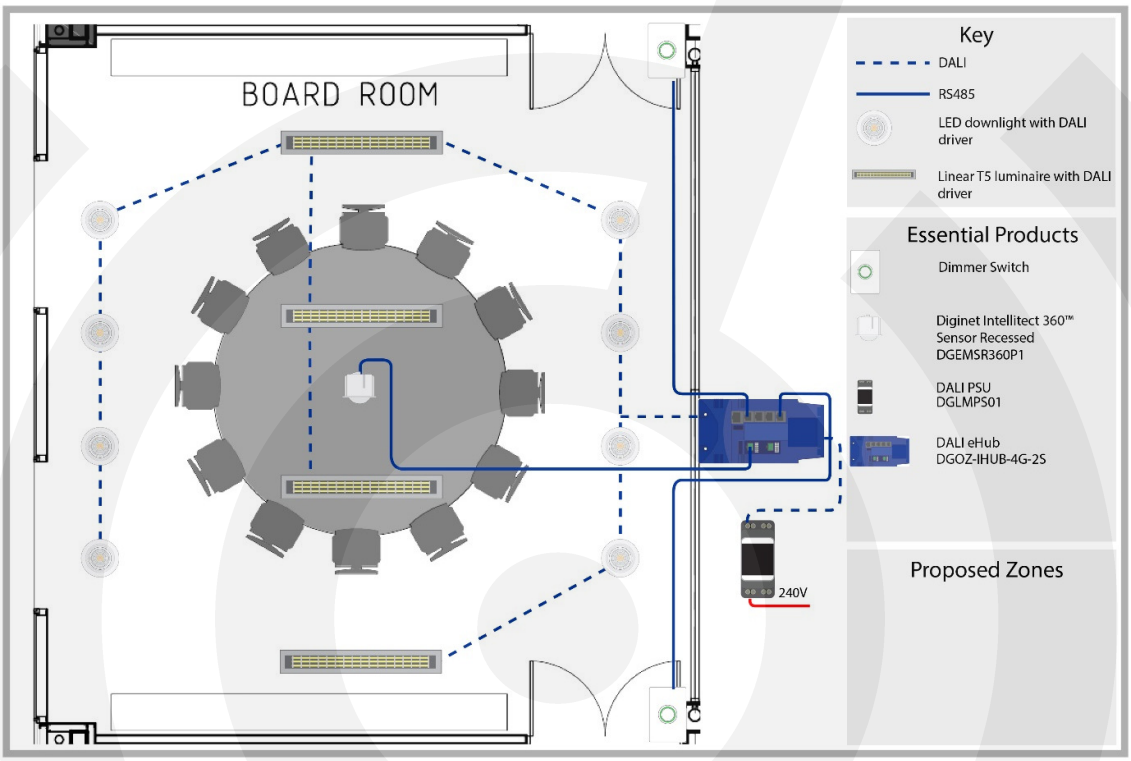
In this example we have a sensor active and the RAPIX Lighting Control System can be programmed to automatically provide some smart energy savings too. There are 2 typical scenarios, but in our example we are assuming a Vacancy operation:

1. **Occupancy** – whereby the sensor will detect the motion of a person entering the room and activate the typical ON scene.
2. **Vacancy** – whereby a sensor will do nothing until a user has activated the lights manually. In this way the user chooses if they needs the lights on or not.

Once the lights are activated by the user, the sensor can operate in the same way. That is:

- If, after a certain amount of time (time-out) the sensor does not see any motion in the room, then dim the lights to a DWELL level.
- If, after a DWELL timeout period the sensor does not see any motion in the room, then dim the lights to off (0%)
- If, after this DWELL timeout period the sensor does see motion in the room, then return the lights to the typical ON scene.

System Schematic: Boardroom Wiring Diagram



This simple Boardroom solution using eHub's and peripherals is easy to design, simple to install and fast to commission.

Application Note - Small Offices

Even though there is a trend toward more flexible workspaces with activity based, open, hot desking scenarios in commercial office space, small offices remain an integral part of the modern office environment.

Whilst some of these small offices will be occupied by the same people each day, others will be used as a quiet workspace or 'Telco' rooms, occupied by different people throughout the day. However these spaces have similar task requirements, comfort and energy savings goals.

Also, due to the size of these small office spaces the number of lighting fixtures are typically small in quantity and hence the level of lighting control applied needs to be considered carefully so as to maximise utility without over-investing.

RAPIX Lighting Control System with its DALI capability and compliance, coupled with its Zoning structure makes designing and implementing multiple small office applications and leveraging the energy savings and comfort benefits of an intelligent office system, simple and inexpensive.

Importantly it is when these small offices and the adjacent and related spaces are included as a part of the lighting control scheme and the system is considered holistically, where energy savings goals and ROI can be fully leveraged.

Any break in this integrated connected lighting control system therefore diminishes its accumulated, reportable energy savings benefits

Common Control Requirements

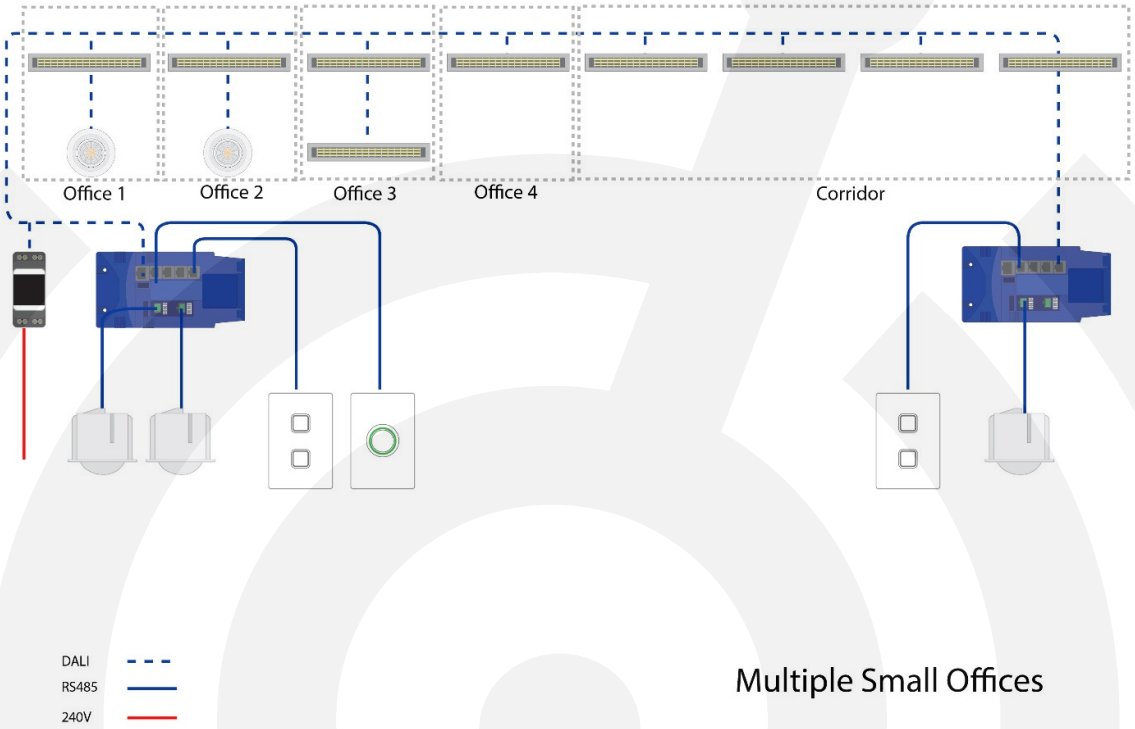
1. Each small office is treated as a separate zone
2. Individual Task tuning to allow the occupant to set the light level that is best for them
3. Sensors to automatically maximise energy savings
4. Consideration for linking the lighting in adjacent corridors, facilities and amenities

Equipment list

Quantity	Product	Part #	Description
2	RAPIX DALI eHub	DGOZ-EHUB-4G-2S	DALI Line controller and RAPIX peripheral input device
1	DALI Power Supply	DGLMPS01	Supplies required DALI power to luminaires and eHub
3	360 PIR Sensor	DGEMS360CL	PIR with 864 fields of view motion/occupancy/vacancy sensor
2	Master wall switch module	DGOZ-MOSW-M-PB	Wall switch
2	Slave wall switch modules	DGOZ-MOSW-S-PB	Wall switch
1	Master rotary wall switch module	DGOZ-MOSW-M-RO	Rotary wall switch

In this example we are assuming we have 4 small offices and an adjacent corridor which leads to other services such as restrooms, kitchen and exits. It assumes we have no more than a single DALI Line where we have no more than 64 DALI devices connected.

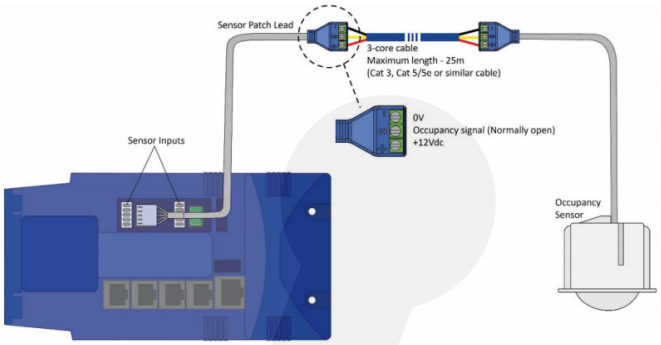
This example does not consider open offices, boardrooms, meeting rooms or multi-floor control. There are separate examples of each of these in this Design Guide. Layering these different lighting control methods with RAPIX Lighting Control System is simple and fast, providing a comprehensive, connected lighting control system.



Multiple Small Offices

How does the equipment get installed and where is it located?

- The DALI PSU (DGLMPS01) receives mains power protected by a suitable MCB upstream. This must be installed in a suitable electrical enclosure.
- The DALI Line is powered by the DALI PSU.
- The 2 x RAPIX eHubs (DGOZ-EHUB-4G-2S) are connected to the same DALI Line as the DALI Luminaires providing a simple wiring topology.
- 3 x sensors (DGEMS360CL) are connected to each RAPIX eHub. As per the diagram below
- The RAPIX eHubs are installed in the ceiling space above the small offices as they fit through a standard 90mm hole.
- The master wall switch modules (DGOZ-MOSW-M-PB) are connected to one of the RAPIX eHubs. These are push button switches
- The slave push button switches connect to the master and are fitted to the different wall plates.
- Wall plates with push buttons are located in 2 of the offices.
- The master rotary wall switch module is connected to one of the eHubs, fitted to a wall plate and affixed to the wall.



RAPIX eHub to Sensor Connection Diagram

Equipment List

Product	Part #	Installation Location
RAPIX DALI eHub	DGOZ-EHUB-4G-2S	Ceiling space
DALI Power Supply	DGLMPS01	Suitable electrical enclosure
360 PIR Sensor	DGEMS360CL	Recessed ceiling
Master wall switch module	DGOZ-MOSW-M-PB	Wall Plate/Wall
Slave wall switch modules	DGOZ-MOSW-S-PB	Wall Plate/ Wall
Master ROTARY wall switch module	DGOZ-MOSW-M-RO	Wall Plate/Wall

1. Office 1 only has a wall switch
2. Office 2 has a sensor but no wall switch
3. Office 3 has a sensor and a wall switch
4. Office 4 only has a Rotary wall switch

This configuration will provide a number of different control scenarios to enable a comprehensive understanding of best practice design with RAPIX Lighting Control System.

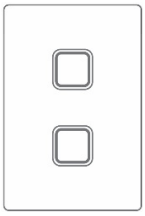
RAPIX Rotary Dial

Day to Day Operation

These small offices will be used by different people, at different times on different days. They are not intended as permanent office spaces.

Each of the small offices operation has been defined separately and this represent just one of many possible, programmable scenarios.

Modular Button and Rotary Operation



In Office 1 and Office 3, a 2 button wall plate has been installed. Each button can be individually labelled to denote its operation clearly. Additionally, the wall switch has a white and an amber backlight.

These wall switches provides the ability to:

- Turn all lighting on and off (top button)
- Dim all the lighting up and down (bottom button).

This LED backlight operation is configurable.

Whilst the RAPIX Lighting Control System is capable of including this control scenario on a single button, the top button for example, it is recommended to split these functions to 2 separate buttons. Why?

It has been observed that when multiple layers of functionality are combined on single buttons, it is quickly forgotten what exact functionality a button serves, even when labelled.

As these office are designed to be used frequently by various staff members, it is more intuitive to expose the control functionality of separate buttons explicitly and label them as such.

In office 4, a Rotary dial has been installed.

The size of the rotary dial can be large or small and this can be decided on site or specified in the design as the product comes with both sizes in the box. We have chosen large to balance the single dial's appearance on the wall panel.

Additionally the coloured ring that is inserted can be changed to 1 of 4 standardised modern colours. Once inserted, the rotary module's included LED backlights will glow through the latex ring.

This LED backlight operation is configurable.

The rotary dial has the ability to:

- Turn all lights on and off by pressing the dial
- Dim the lights up and down by rotating the dial left and right respectively.

Note that no labelling is required to convey this operation to the occupant due to the simplicity of the Rotary Dial interface.

The speed at which the lights dim when the dial is rotated is also configurable during the system commissioning.

This is a difficult thing to explicitly design for and is best determined on site during light level settings. Nonetheless the RAPIX Lighting Control System provides designers the capability quicken or slow the speed at which lights dim via the simple rotary interface.

SENSOR OPERATION EXPLAINED - Vacancy Operations

In this example we have a sensors active and the RAPIX Lighting control can be programmed to automatically provide some smart energy savings.

Vacancy Mode – whereby a sensor will do nothing until a user has activated the lights manually. In this way the user chooses if they needs the lights on or not. This can serve to provide greater energy savings.

Once the lights are activated by the user, the sensor operates as described below:

- If, after a certain amount of time (time-out) the sensor does not detect any motion in the room, then dim the lights slowly (~30 seconds) to a DWELL level.
- If, after a DWELL timeout period the sensor has not detected any motion in the room, then dim the lights slowly (~10 seconds) to off (0%)
- If motion is detected during the DWELL period then dim the lights up, quickly (less than 1 second) to the previous level.

This vacancy operation mode for the sensors has been selected to maximise the energy savings possible and provide occupants the choice to use the lighting, rather than having to use the lighting.

Additionally as we have a small office without a sensor and only a wall switch (office 4) if the occupants needed lights in this situation they will have to activate the lighting via the rotary wall switch. Therefore this vacancy operation provides continuity to the control methodology and serves to clarify occupants understanding of how the lighting system typically works.

Note however, for the purpose of this example that Office 2 does not have a wall switch and therefore the sensor will be in complete control of the lighting in Occupancy Mode. That is, upon detection of motion activate the lighting in the zone. Thereafter, the time-out and dwell period remain the same.

Corridor Hold Off

Each of the 4 offices connects to a corridor which provides emergency egress and another corridor which provides access to a kitchen and amenities. (Not pictured)

Therefore it is desirable to link these offices to corridors in such a way that should any of the office remain occupied, then the corridors, kitchen and amenities will also remain illuminated.

Likewise, when none of the offices are in use it may be desirable to dim the access corridor but keep the kitchen and amenities on for other staff in different parts of the building.

There is a sensor in the corridor as staff often enter the building via the fire stairs.

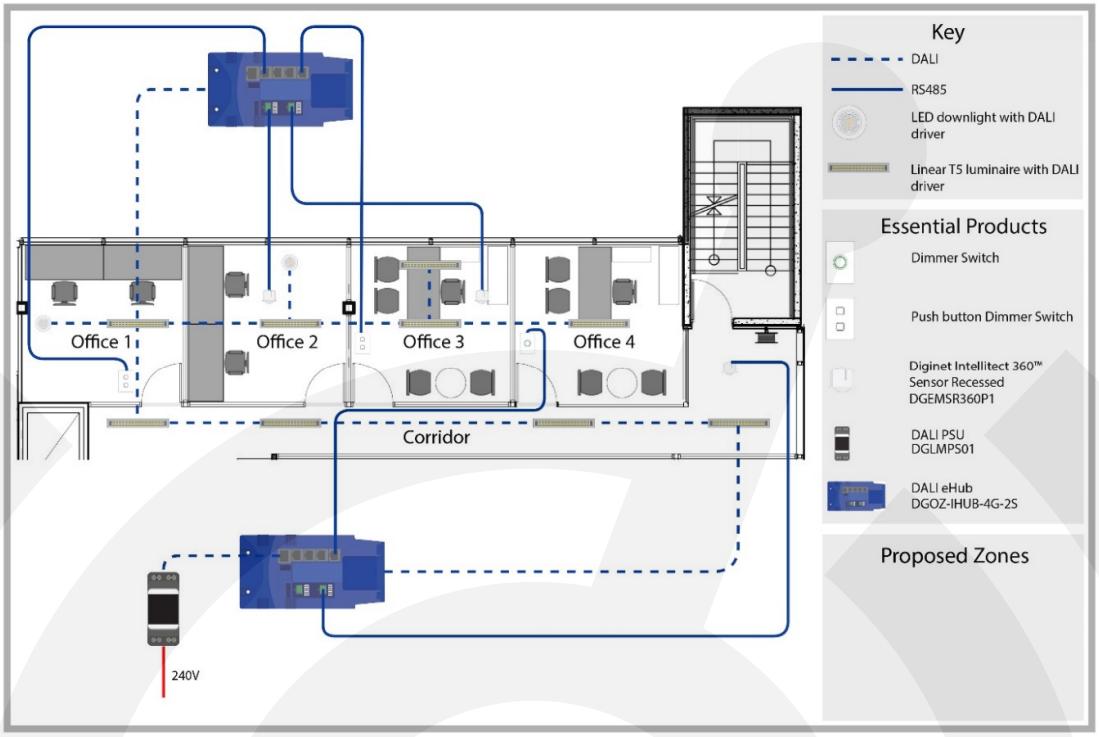
The RAPIX Lighting Control System is capable of undertaking this corridor hold-off (a.k.a corridor linking) to maximise energy savings and ensure that no-one is left in a pool of light and can safely egress or make use of the facilities, especially if they are the last person if the office.

Basic Operating Design

1. When any of the offices are in any state except off, then the corridors, kitchen and amenities will remain on.
2. When all offices are off, then the corridor dims to a standby level.
3. When the first person arrives in the morning the corridor sensor instructs RAPIX to illuminate the corridor, amenities and kitchen. It does not affect the offices. Note that the corridor is dependent on the offices NOT the offices depending on the corridor.
4. When all offices are off, and the corridor lights are in standby, if another occupant enters via the fire stairs the corridor lights are dimmed quickly (less than a second) to the on state.

Further logic for this scenario is described later in the document in the whole building operation where use of time clocks for time of day logic tests and systems states provide further flexibility and more sophisticated control.

RAPIX eHub to Sensor Connection Diagram



Office 1 Operation

- To activate the lighting, the occupants must use the wall swicth in the office. This provides on/ off and dimming control.
- This office is linked to the corridor. Whenever it is on, the corridor will remain on.
- When it is off AND all other dependent office are off the corridor can turn off too.
- At the end of the working day the users can turn their lights off from the office wall swicth, or use a master wall switch as detailed in the Open Office Scenario, later in this Design Guide.

Office 2 Operation

- When the occupants enter the office the sensor detects motion and illuminates the office. As there is no wall switch in this office the sensor has complete control.
- This office is linked to the corridor. Whenever it is on, the corridor will remain on.
- When it is off AND all other dependent office are off the corridor can turn off too.
- At any time during the day, when the occupant vacates the office, the sensor will work through its dim to dwell/dim to off scenario.
- If off and another occupant enters, the sensor re-activates the lighting system.

Office 3 Operation

- This office has both a wall switch and a sensor. The sensor is operating in vacancy mode.
- To illuminate the office, the user must use the wall switch. This provides on/off and dimming control.
- This office is linked to the corridor. Whenever it is on, the corridor will remain on.
- When it is off AND all other dependent office are off the corridor can turn off too.
- At any time during the day, when the occupant vacates the office, the sensor will work through its dim to dwell/dim to off scenario.

- If the system extinguishes the lighting in the office, when an occupant re-enters it is necessary to use the wall switch to activate the lighting.

Office 4 Operation

- Same operation as office 1
- A rotary dial is provide for simple on/off/dim up/down control instead of a wall switch
- All other logic rules remain the same.

Application Note - Open Offices

Open office applications are most commonly specified in commercial buildings today and encompass a number of lighting control scenarios.

> For brevity none of the boardroom or small office applications are detailed in this section as they have a dedicated section of their own. It is acknowledged that most open offices also encompass boardrooms, meeting rooms and multiple small offices as an holistic solution.

When designing a RAPIX Lighting Control System for these different types of areas, the system components and logical, programmed operations will work seamlessly together. This layering of lighting control applications is simply achieved with RAPIX Lighting Control System.

Open office lighting control expectations are changing rapidly and the current focus is on:

- Occupancy comfort and indoor environmental quality
- Compliance to necessary building codes
- Simplicity in design and maintenance
- Flexibility to simply and easily change system operation so it meets current business needs

Common Control Requirements for Open Plan Office

1. Zoning control of open areas to BCA /NCC especially with zoning and automatic control of lighting via sensors.
2. Daylight harvesting for luminaires in perimeter zones, atrium areas and other areas which receive significant natural light.
3. Control panels providing zoned control of office areas to ensure not all lighting on a floor is turned on when the first person arrives; to ensure that not all lighting remains on, if no-one is present.
4. After hours functionality. How the lighting will operate outside on normal operating hours, or in the case of 24 hour call centres, how the lighting system will operate at different time of the day or night.
5. Corridor hold off scenarios whereby office corridors and amenities are maintained in an illuminated state if any associated offices or areas remain occupied.

Open Office Example Equipment List:

Quantity	Product	Part #	Description
3	RAPIX DALI eHub	DGOZ-EHUB-4G-2S	DALI Line controller and RAPIX peripheral input device
1	DALI Power Supply	DGLMPS01	Supplies required DALI power to luminaires and eHub
4	360 PIR Sensor	DGEMS360CL	PIR with 864 fields of view motion/occupancy/vacancy sensor
2	DUAL Tech Sensor	CM-PDT-9-AU	Dual technology PIR and Microphinics sensor.
1	Master wall switch module	DGOZ-MOSW-M-PB	Wall switch

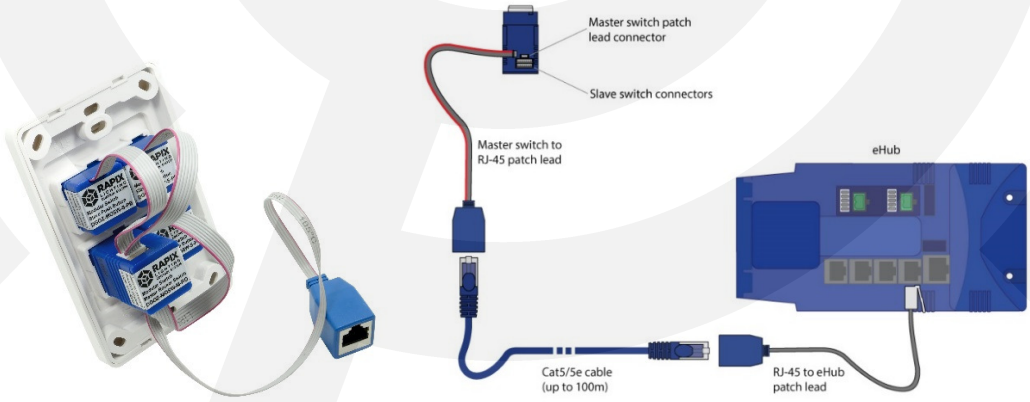
Quantity	Product	Part #	Description
5	Slave wall switch modules	DGOZ-MOSW-S-PB	Wall switch
1	2 Channel DALI Relay	DGOZ-RLY-10A-02	DALI Relay for switching non DALI lighting.

In this example we are assuming we have up to 50m^2 of open office space, excluding any kitchen, facilities, small offices, meeting rooms or boardrooms. We are assuming we have no more than 63 DALI luminaires which need to be controlled and some non-DALI luminaires which need to be controlled too.

How Does the Equipment Get Installed and where is it Located?

- The DALI PSU (DGLMPS01) receives mains power protected by a suitable MCB upstream. This must be installed in a suitable electrical enclosure.
- The DALI Line is powered by the DALI PSU.
- The 2 x RAPIX eHubs (DGOZ-EHUB-4G-2S) and the 2 Channel DALI Relay (DGOZ-RLY-10A-02) are connected to the same DALI Line as the DALI Luminaires providing a simple wiring topology.
- The DALI Relay device will be controlling the non-DALI lighting in the male and female amenities and can be mounted in the ceiling space above these areas. If space does not permit, a din rail mounting kit is available for installation in an electrical switchboard.
- 2 x sensors (DGEMS360CL) are connected to each RAPIX eHub in the open office area.
- Additionally 2 Dual Tech sensors (CM-PDT-9-AU) are connected to the RAPIX eHub servicing the amenities area.
- The RAPIX eHubs are installed in the ceiling space as they fit through a standard 90mm hole.
- The master wall switch module (DGOZ-MOSW-M-PB) is connected to one of the RAPIX eHubs as per the diagram below. This is a push button switch.
- The slave push button switches connect to the master and are fitted to the wall plate.

RAPIX eHUB to Master Modular Switch Connection Diagram



Product	Part #	Installation Location
RAPIX DALI eHub	DGOZ-EHUB-4G-2S	Ceiling space
DALI Power Supply	DGLMPS01	Suitable electrical enclosure
360 PIR Sensor	DGEMS360CL	Recessed ceiling
DUAL Tech Sensor	CM-PDT-9-AU	Surface ceiling
Master wall switch module	DGOZ-MOSW-M-PB	Wall Plate/Wall
Slave wall switch modules	DGOZ-MOSW-S-PB	Wall Plate/ Wall
2 Channel DALI Relay	DGOZ-RLY-10A-02	Ceiling space

Day to Day Operation

Open office spaces are utilised by its occupants in different ways at different times of the day. Ideally the lighting control system will automatically ensure that both user comfort and potential energy savings are maximised around the ebb and flow of the workforce in the open office space.

This example of an open office area operation is uncomplicated and will simply achieve the occupancy and energy savings goals of most clients.

The Modular Wall Switch with 6 push buttons is mounted at the main entry to the open office space. Each button can be individually labelled to denote its operation clearly. This wall switch provides the ability to:

- Turn all lighting on and off.
- Activate/Deactivate lighting in each zone independent from the other zones.
- Provide specialized scene recall for cleaning and security requirements.

If an individual is the first to arrive, they can choose to operate the lighting via the wall switch, or not. Depending on which zone she works in, the 'first arriver' may walk through other zones to reach her workspace. In this scenario the sensors would detect her moving and activate the lighting in those zones as well as in her allocated space.

If she arrives well before the remainder of the office occupants, the sensors would automatically work to dim and extinguish the other lighting zones in line with their time out periods. Likewise if she were last to leave, the sensors would do their job in the other zones in the same fashion.

When other occupants arrive and move into their workspace the sensors takeover control of the lighting. This simple operation ensures lighting is provided in the right place at the right time and saves energy and money automatically.

Sensor Operation

The sensors mounted throughout the open office zones operate in occupancy mode whereby, when occupancy is detected, the lighting in the zone is activated.

After a timeout period – a time when no motion has been detected – the RAPIX Lighting Control System will dim this zoned area to a dwell level. If no further motion is detected after a dwell timeout the lighting will be extinguished. If motion is detected the appropriate lighting level will be restored, whether in dwell or off state.

Corridor Hold Off

As in the small office example, there is a desire not to leave an individual in a pool of light without clear egress paths or paths to amenities.

The RAPIX Lighting Control System provides the ability to simply provide a corridor hold off facility.

Essentially each of the main lighting zones has a connected dependency to the corridor and amenity zones. In this way when any of the open office areas are in any state other than off, the corridors and amenities remain on.

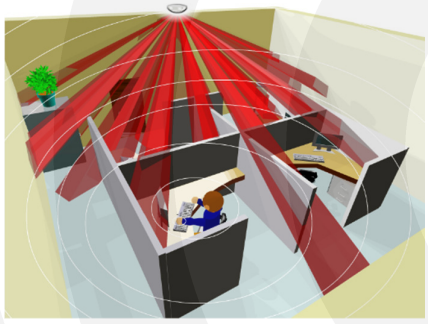
When the last occupant leaves for the evening they can choose to turn all the lighting off from the wall switch, including the corridors and amenities. Alternatively they can do nothing and the system and sensors will extinguish all open office area lighting, in time.

Once all open office areas with the connected dependency are off, then the system will automatically extinguish the amenities and corridor lighting.

Dual Technology Sensors

Likewise the dual technology sensors in the male and female toilet zones operate in occupancy mode. However these sensors will often have a shorter time out period than those in the open office space.

Additionally, as these are dual technology sensors - PIR and Microphonics – their operation is more finely tuned to a restroom environment. These sensors operate with first activation coming from the PIR component. That is, motion detected so the lights switch on.



Thereafter, for the dual technology sensor to maintain the lighting in an on state, both the PIR and the Microphonic sensors work together to detect motion or sound.

When either is detected the lighting is kept on.

When no motion or sound is detected for the time-out period, the dual technology sensor will instruct the system to turn the lights off.

As a redundancy, the microphone continues to listen for 10 seconds after the lights are turned off for voice reactivation making it ideal for restrooms.

As the RAPIX Lighting Control System has a 2 channel DALI relay in this example, we are able to control non DALI lighting, which is assumed to be installed in the restrooms. As these are relays with the ability to switch lighting on and off only, it is not possible in this scenario to dim the lighting to a dwell level prior to extinguishing the lights.

Each channel on the DALI relay is assigned a DALI Short Address and can be configured to operate much like any other DALI device in an ON and OFF state only.

For open offices larger than the one described, the operation, logic and ebb and flow is duplicated to provide a cohesive lighting control system which achieves the occupancy comfort and energy savings goals.

Note that this open office scenario is one example of an open office operation and does not encompass all scenarios, system capabilities or logic functions possible. In the following example more sophisticated control scenarios are provided.

Application Note - Multi-Level Office Tenancy to a Whole Office Building

RAPIX Lighting Control System provides designers the ability to scale lighting control solutions from a single boardroom to an entire office building.

Using the previous scenarios as a foundation, this Practical Application Note focuses on single and multi-floor implementation of a RAPIX Lighting Control System.

Using the framework provided from single DALI Lines designers can simply scale the RAPIX system to service an entire office building with the same basic principles and the same hardware components.

RAPIX Zone Controller

In a Multi-Level Office Tenancy and whole building applications the only additional hardware to be introduced is the **RAPIX Zone Controller**.

The RAPIX Zone Controller is a 4 DALI Line controller which is mounted in a switchboard, connected to an Ethernet network and terminated to 1 or more DALI Lines to control the lighting.

DALI Cross Line Communications

In office buildings with large floor plans it is common to require more than the 64 DALI devices a single DALI Line can provide.

The RAPIX Zone Controller provides designers with significant capacity of 4 DALI Lines for very little electrical switchboard space. These 4 DALI Lines provide 100% DALI compliant control of up to 256 devices.

As part of this typical design process zones such as boardrooms, small offices, meetings rooms and open office areas will have luminaires from different DALI Lines which need to be controlled seamlessly together.

This is called DALI cross line communication.

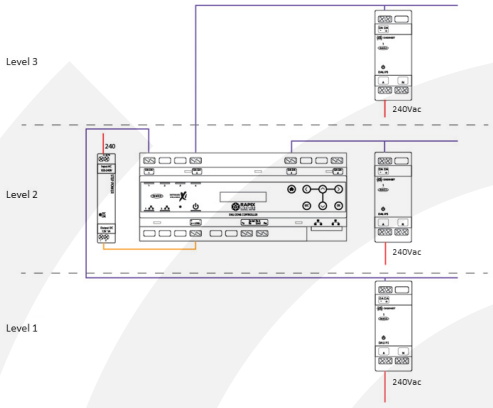
With the RAPIX Zone Controller, you as the designer do not need to concern yourself with identifying which DALI Line a luminaire will be terminated to. Your focus can be on creating the most functional lighting design to meet your customer's needs rather than being limited to how the technology needs you to design.

In fact, the only number designers need to consider is 64. If there are more than 64 devices in the floor plan you are designing, simply add another DALI Line. Configuration of the zones is done quickly and easily with the commissioning software.

This simplifies how designers create floor plans and saves significant time in both the design and redesign phases of the project.

Whilst DALI is capable of supporting 64 DALI devices per DALI line it is generally good practice to not load the DALI line to its capacity as part of the initial design. Choosing a number such as 55 as the maximum number of devices per DALI line provides designers flexibility to add more during the design/redesign phase should the need arise. It also provides capacity during the installation to add more DALI devices if things change at the last minute or on site conditions require some changes.

More Design Freedom



1 Zone controller servicing multiple floors

With this large DALI capacity from a single device, the way multi-level office tenancies are designed can be modified to save time and money without sacrificing lighting control sophistication or capabilities.

One or more RAPIX Zone Controllers are not always required to be installed on every floor. In fact, it makes fiscal sense not to follow this historical installation method and to leverage the full capacity of the 4 DALI Lines across multiple floors.

As the DALI power supplies are a separate device, it is possible to install the DALI power supplies on different floors to the Zone Controller itself.

Then, the DALI control cabling can be fed up and down the electrical riser, connected to the DALI power supply on each of the floors and achieve the exact same control capability.

This saves money by eliminating the need to have a DALI Line controller on every floor, saves time during the installation and reduces the size and number of poles needed in electrical enclosures.

This design methodology is well within Australia Design standards and is most useful when the same tenant occupies multiple levels in an office building.

Common Control Requirements for Whole Office Building Control

- Increasing the number of lighting control zones by decreasing the size of these zones for finer control and adherence to BCA and NCC codes.
- Proliferation of sensors to automate lighting control and provide additional information
- Focus on indoor environmental quality
- Centralised monitoring, control, scheduling, reporting for the facility manager
- Integration with Building Management Systems (BMS)
- Integration of other services such as Audio Visual (AV)

It is assumed that the common control requirements from the other application notes also apply here.

Multi-Level Office Equipment List

Quantity	Product	Part #	Description
1	RAPIX Zone Controller	DGOZ-ZONEC-4DA	4 DALI Line Controller
9	RAPIX DALI eHub	DGOZ-EHUB-4G-2S	DALI Line controller and RAPIX peripheral input device
3	DALI Power Supply	DGLMPS01	Supplies required DALI power to luminaires and eHub
12	360 PIR Sensor	DGEMS360CL	PIR with 864 fields of view motion/occupancy/vacancy sensor
6	DUAL Tech Sensor	CM-PDT-9-AU	Dual technology PIR and Microphonics sensor.
3	Master wall switch module	DGOZ-MOSW-M-PB	Wall switch
15	Slave wall switch modules	DGOZ-MOSW-S-PB	Wall switch
3	2 Channel DALI Relay	DGOZ-RLY-10A-02	DALI Relay for switching non DALI lighting.
1	RAPIX Head End GUI Software	DGOZ-VIS-5C	Visualisation/ GUI software and BMS integration drivers.

In this example a single multi-level tenancy is provided. The control concepts presented here can simply be duplicated to scale beyond the 3 levels presented herein as the concepts remain the same. Likewise the system capabilities and capacities are identical.

Therefore the focus of this application note will be detailing the additional design considerations and control possibilities due to the introduction of the Zone Controller.

How does the equipment get installed and where is it located?

- On each floor the DALI PSUs (DGLMPS01) receive mains power protected by suitable MCBs upstream. These must be installed in a suitable electrical enclosure.
- 3 of the DALI Lines are powered by the DALI PSU. 3 of the 4 available DALI Lines are being used.
- The RAPIX Zone Controller (DGOZ-ZONEC-4DA) is powered from a separate switch mode power supply (provided with the Zone Controller).
  - This is in turn connected to mains power and protected upstream by an MCB.
  - This can be the same MCB used to protect the DALI PSU in this board.
- Zone Controller is connected to the office building's Ethernet or ICN (Integrated Communications Network) from one of its dual Ethernet ports.
- Each DALI Line has 3 x RAPIX eHubs (DGOZ-EHUB-4G-2S) and 1 x 2 Channel DALI Relay (DGOZ-RLY-10A-02) connected to the same DALI Line as the DALI Luminaires providing a simple wiring topology.
- The DALI Relay device will be controlling the non-DALI lighting in the male and female amenities and can be mounted in the ceiling space above these areas. If space does not permit, a din rail mounting kit is available for installation in an electrical switchboard.
- 4 x sensors (DGEMS360CL) are connected to 2 of the 3 RAPIX eHubs installed on each level.

- Additionally 2 Dual Tech sensors (CM-PDT-9-AU) are connected to the unused RAPIX eHub servicing the amenities area.
- The RAPIX eHubs are installed in the ceiling space as they fit through a standard 90mm hole.
- The master wall switch module (DGOZ-MOSW-M-PB) is connected to one of the RAPIX eHubs. This is a push button switch.
- The slave push button switches (DGOZ-MOSW-S-PB) connect to the master and are fitted to the wall plate.
- The RAPIX Head End GUI software is installed on a Windows 7 (or higher) PC. The PC is connected to the ICN to allow communications with the Zone Controller.

Product	Part #	Installation Location
RAPIX Zone Controller	DGOZ-ZONEC-4DA	Electrical Switchboard
RAPIX DALI eHub	DGOZ-EHUB-4G-2S	Ceiling
DALI Power Supply	DGLMPS01	Electrical Switchboard
360 PIR Sensor	DGEMS360CL	Flush ceiling
DUAL Tech Sensor	CM-PDT-9-AU	Ceiling mount
Master wall switch module	DGOZ-MOSW-M-PB	Wall plate/Wall
Slave wall switch modules	DGOZ-MOSW-S-PB	Wall plate/Wall
2 Channel DALI Relay	DGOZ-RLY-10A-02	Ceiling
RAPIX Head End GUI Software	DGOZ-VIS-5C	Desktop, laptop PC or Din-Rail mounted PC

It is important to note that the Zone Controllers connect to an Ethernet network. Typically this network will be provided as part of the integrated communications network infrastructure provided in the building.

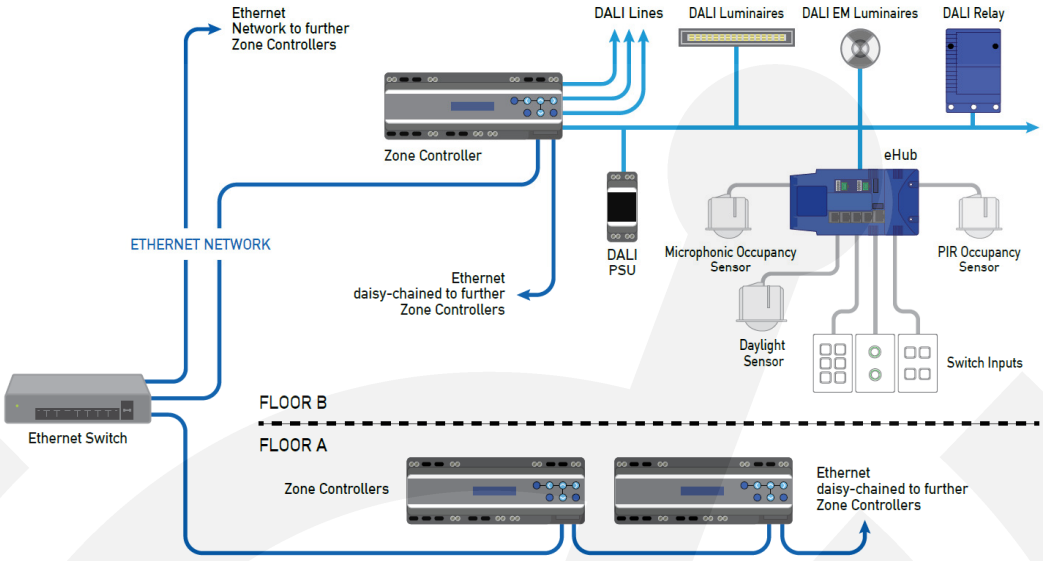
However if this ICN does not exist, or an Ethernet network is not available to be used, then additional cabling and typical network infrastructure components will need be installed and supplied. Space to mount these additional components will also be necessary.

These networking infrastructure components are not supplied by Diginet and do not encompass part of the RAPIX Lighting Control System offering. These are standard networking components and selection of these should be aligned with ICT consultants and designers.

A minimum of CAT5 UTP/STP cable and standard RJ45 pin out configurations are used for Ethernet connections. There are no special cabling requirements for Zone Controller connectivity. Standard Ethernet limitations apply.

These include:

- The maximum allowed length of a CAT cable is 100 meters (328 ft). This consists of 90 meters (295 ft) of solid "horizontal" cabling between the patch panel and the wall jack, plus 10 meters (33 ft) of stranded patch cable between each jack and the attached device
- Limit of 10 continuous connections when looping between the Zone Controller's dual Ethernet switch.



Typical Multi-floor system topology

Day to Day Operation

To understand the additional functionality now available due to the introduction of the Zone Controllers it is necessary to understand what those features are.

The Zone Controller features include:

1. Zones
2. DALI Line Joining/ Cross DALI Line communications
3. Time scheduling
4. Operating Properties and System Modes

Points 1 & 2 are basic operating principles of the RAPIX Lighting Control System using Zone Controllers. These serve to simplify DALI configuration and remove complexity when commissioning and designing DALI systems. These are covered elsewhere in this Design Guide.

Time Scheduling

All Zone Controllers have the capability to provide complete astronomical time scheduling events with associated actions.

This means that scheduling can be linked to an absolute time or linked to the sunrise and sunset of any location globally according to longitude and latitude.

Time scheduling is essential in office applications to maximise energy savings and enable the designer to define when certain energy savings methods are implemented.

Some common scheduling events for office spaces include:

- Turning indoor lighting on and off automatically
- Controlling outdoor security and architectural lighting automatically
- Controlling internal security lighting automatically
- Transitioning internal lighting from a day scene to a night scene automatically
- Activate and de-active sensors and wall panels

System Modes

Systems modes enable the designer to determine alternate system operations depending on what state the system has been placed into.

Examples of these include:

- Night Mode
- Day Mode
- Panic Mode
- Load Shed Mode

Systems modes can be applied to an entire installation or to specific zones. In this way, control of a Zone from a wall switch (for example) depends on the System Mode in which the Zone has been placed.

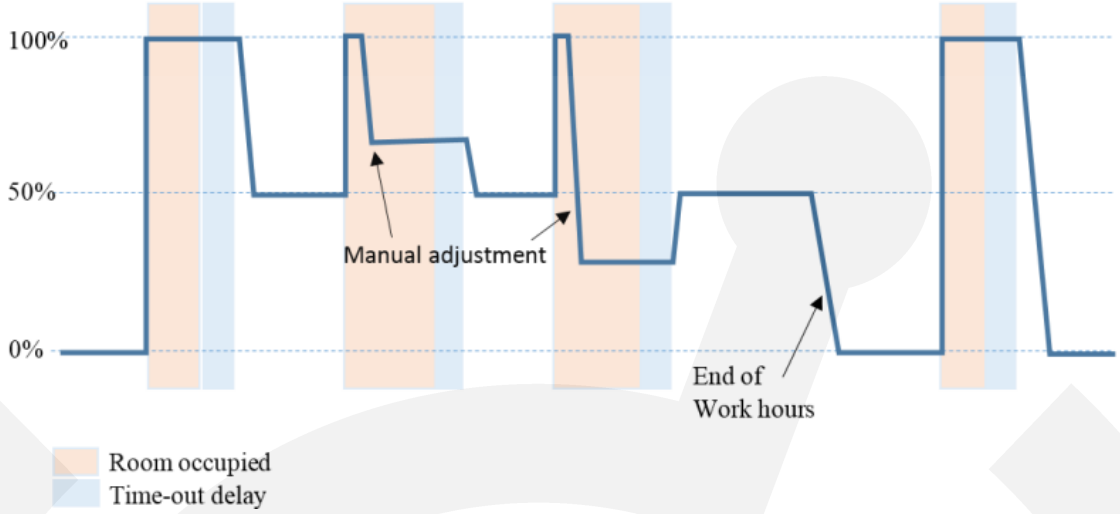
System modes are most commonly used with the RAPIX Lighting Control System when linked to a Time Scheduled event. By using Time Scheduling, the system can be automatically placed into a different mode of operation, precisely and automatically.

In this example we have a sensor in a small office, which also has a wall switch for manual control.

The RAPIX Zone Controller has enabled the designer to introduce a day and night operation by my implementing a Time Scheduled System Mode change. At 7pm every evening the entire system is transitioned into a night mode. At 7am every morning the system is transitioned back into a day mode.

There is practically no limit to the number of different System Modes providing ultimate design flexibility and sophistication.

Day Operation	Night Operation
• When sensor detects motion, illuminate zone with no fade. • After time out delay, fade to DWELL scene of 50% • Stay at 50%. If motion is detected go to 100% with no fade. • Wall switch allows lighting in room to be dimmed to any level, including below dwell level. • If lighting dimmed (no matter the level) and motion time out, then fade to DWELL scene of 50%.	• When System Mode transitions to NIGHT OPERATION, extinguish lighting. • When sensor detects motion, illuminate zone with no fade. • After time out delay, extinguish lighting with a fade time. • Wall switch allows lighting in room to be dimmed to any level. • If lighting dimmed (no matter the level) and motion time out, then extinguish lighting with a fade.



In this simple example transitioning from day mode to night mode has removed the 50% DWELL functionality. In practical terms this is a sensible, energy saving strategy.

During normal business hours when the room in unoccupied the lighting remains at the 50% level. However during afterhours when less staff are present, the lighting is instead extinguished completely when the room is unoccupied

Corridor Hold off with System Modes

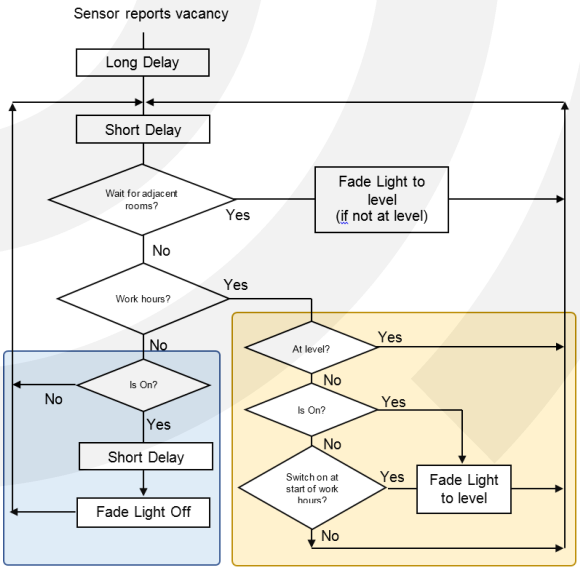
A similar result can be achieved with the corridor hold off functionality.

The purpose of the corridor hold off is to ensure that corridors, which provide safe egress path and paths to amenities, remain on if people remain present in adjacent offices.

For example, if a Time Schedule was programmed to provide a floor shut down sweep, any of the offices that still had occupancy the dependent corridors would also remain illuminated.

A general-purpose corridor template will perform these functions:

- Switch on light to 100% when a person is detected in the corridor or in a dependent office, and stay on for a selected time.
- At end of delay, set to a selectable level which may vary according to whether it is work/after hours
- Optionally keep lights on at a selectable level if dependent adjacent rooms are occupied
- Optionally switch lights on at start of work hours
- Switch light off at end of work hours



Other Typical Timed Based System Mode Operations

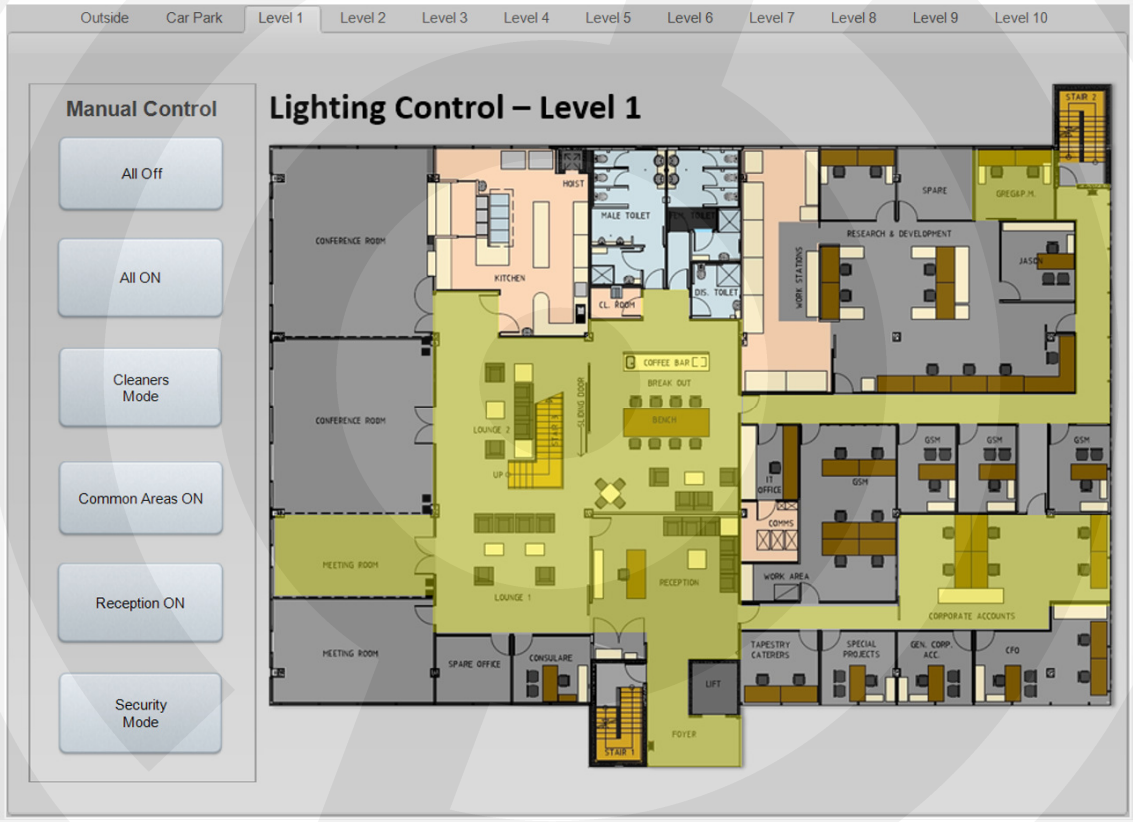
There are a wide range of Time Scheduling and System Mode configurations which can increase energy savings in commercial offices and other commercial spaces. Some of these include:

- After Hours Extension – see Lighting Control Methods in Appendix
- Security Walk Through – see Lighting Control Methods in Appendix
- After Hours Cleaners – see Lighting Control Methods in Appendix
- Disable/Enable sensors – see Lighting Control Methods in Appendix

Each of these operate in a similar methodology to the 2 examples provided above.

A System Mode is automatically activated via a Time Schedule, and this system mode modifies the manner in which the system operates to maximize energy savings and ensure occupant comfort more precisely for the time of day and typical activities undertaken during that period.

Then, the Time Schedule transitions to the alternate mode to maximise energy savings and comfort based on typical occupancy for that time of day. This System Mode transitioning could occur twice – from day to night mode, for example, or many times throughout the day if needed.



BMS (Building Management System) Integration

When designing lighting control systems for multiple floors or entire buildings it is commonplace for these buildings to have multiple different systems running the different components of the buildings.

It is logical to provide simple integration between these building management systems and the lighting control system to leverage the collective power and intelligence these systems offer facility managers. For example, lighting monitoring and failure detection can then be integrated with maintenance reporting of other building services.

When the system co-operate greater energy savings can be achieved, often without human intervention. This is known as Smart Buildings or Intelligent Buildings.

RAPIX Lighting Control System provides seamless integration to many Building Management Systems including:

- BACNET
- LON
- MODBUS

This means that RAPIX Lighting Control System can easily be integrated to receive messages from and transmit messages automatically to other systems which are also connected to the BMS system to achieve the most energy efficient integrated Smart Building.

For example with the use of RAPIX motion sensors to automatically activate and deactivate lighting when a space is occupied, these same messages are easily mapped to leverage automated control of the HVAC and shading solutions in those rooms too.

These other systems include:

- HVAC
- Security Access
- Shading systems
- Fire Systems

How does BMS Integration work?

This is achieved by use of software drivers embedded in the Graphical User Interface (GUI) software. In this way a single embedded PC, desktop PC or laptop PC can perform both the system duty of providing and intuitive, easy to use GUI as well as a BMS integration platform.

The PC with the head end software must be on the same network and in the same IP address range as the Zone Controller network. The RAPIX driver automatically queries the Zone Controller network and exposes all available Zones and control points in these zones in the software.

Likewise for the BMS system, the integrating system is queried, control points returned and made available to map to RAPIX Zones.

AV (Audio Visual) and 3rd Party System Integration

Integration to 3rd party systems is done at a high level or a low level.

A low level typically consisting of a dry contact output from the AV system to RAPIX. As the RAPIX eHub has 2 fully programmable dry contact inputs, this low level interfacing is a straight forward method to control the RAPIX Lighting Control System.

Low level is best used where there are only a small number of interfaces required and where a system does not provide a high level alternative.

High Level 3rd Party interfacing

A high level interface with RAPIX Lighting Control System is achieved by connecting all systems which need to be integrated to the Ethernet network.

There is no need for any additional gateways or hardware interfaces to achieve this integration.

RAPIX Lighting Control System provides a freely available JSON scripting interface which provides for secure, encrypted, authenticated communications between systems.

With this simple scripting, 3rd party devices can:

1. Send messages to the RAPIX Lighting Control System to control zones by scenes
2. Query the system status of any zone and the members of that zone
3. Trigger lighting actions based on a logical condition from the 3rd party system.

If part of your RAPIX Lighting Control design is intended to interface with any 3rd party or BMS system it is recommended to specifically detail those systems and the intent of those connections.

That is, if you would like the AV system to control the lighting in the all of the boardrooms, detail that specifically in your design documents as well as the method of the integration – high level or low level – and the desired outcome from that integration.

In this example *"... all of the boardrooms provide a high level interface with the RAPIX Lighting Control System which provides for the selection of lighting scenes and task tuning (dim down/fade up) capability..."*

This level of detail in the design phase obviates the need for further questions back to the designer regarding method and intent of the integration. This saves designers time and provides an undisputable performance expectation.

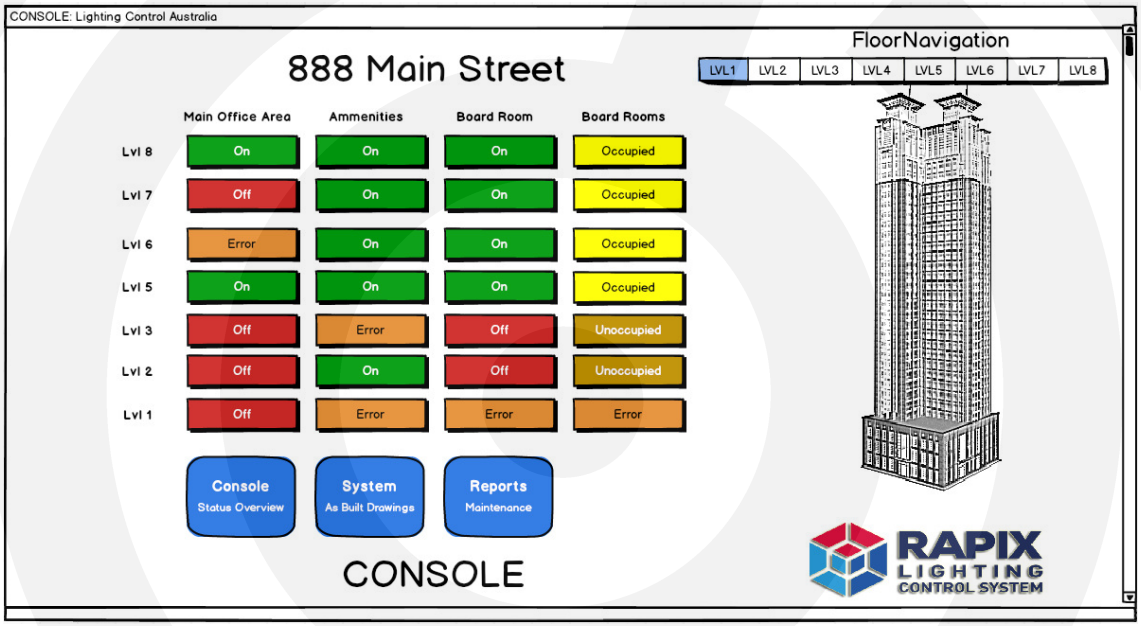
GUI (Graphical User Interface) Operation

RAPIX Lighting Control System provides end users and facility managers a sophisticated Graphical User Interface experience.

Using the same integrated PC software used for BMS integration, a wide range of services are available for controlling, monitoring, scheduling and reporting on the lighting control system.

The GUI Visualisation software allows for:

- Importation of floor plan overlays
- Importation of as built drawings
- Page navigation
- System control buttons
- Status and Alert icons
- Error reporting and plotting of energy consumption
- Astronomical scheduling
- Conditional and sequential logic scenarios



A typical scenario that can be designed as part of an open office plan allows for a number of 'pages' which have a floor plan to represent each floor in the project.

Other common GUI elements include:

- On each floor plan, there are navigation buttons to allow simple access to other floors simply.
- A dedicated 'Console' page will often be created to represent the building as a whole, with floor by floor status indicators.
- This allows facility managers to view the entire lighting control system on a single page and identify if anything needs attending or if there is something unusual occurring
- A dedicated page for System 'as built' drawings, visualizing the system topology
- A reporting page for errors and historical data reporting

If part of your RAPIX Lighting Control design is to include a GUI for Facility Managers or End Users it is recommend to specifically detail the attributes of the GUI and your intent in providing this interface.

For example *"... A GUI will be provided which will visualize each floor of the building and provide the facility manager a simple tool to review system operation and determine operational status...etc.*

These floor plans will be imported from the final project drawings and will show each of the common lighting control zones in a different colour. Open plan offices will be yellow, amenities will be blue, corridors and egress paths will be green...etc.

The GUI will have a Console or overview page which provides 'status at a glance' to the facility manager as to the operation and health of the lighting control system and these common zones on each floor.

The GUI will provide modern navigation buttons or Tree navigation structure to allow easy selection of each the different floor plan levels...etc.

Emergency Lighting Monitoring System

The Australian Standard for Emergency Lighting Testing & Inspection, AS2293.2, details the periodic inspection and maintenance necessary to ensure that the emergency evacuation lighting systems are operational at all times.

The RAPIX DALI Emergency Monitoring System is a sophisticated system that ticks all the boxes for AS2293 compliance.

RAPIX Emergency automatically carries out all the required AS2293 testing and reporting. It includes the following features.

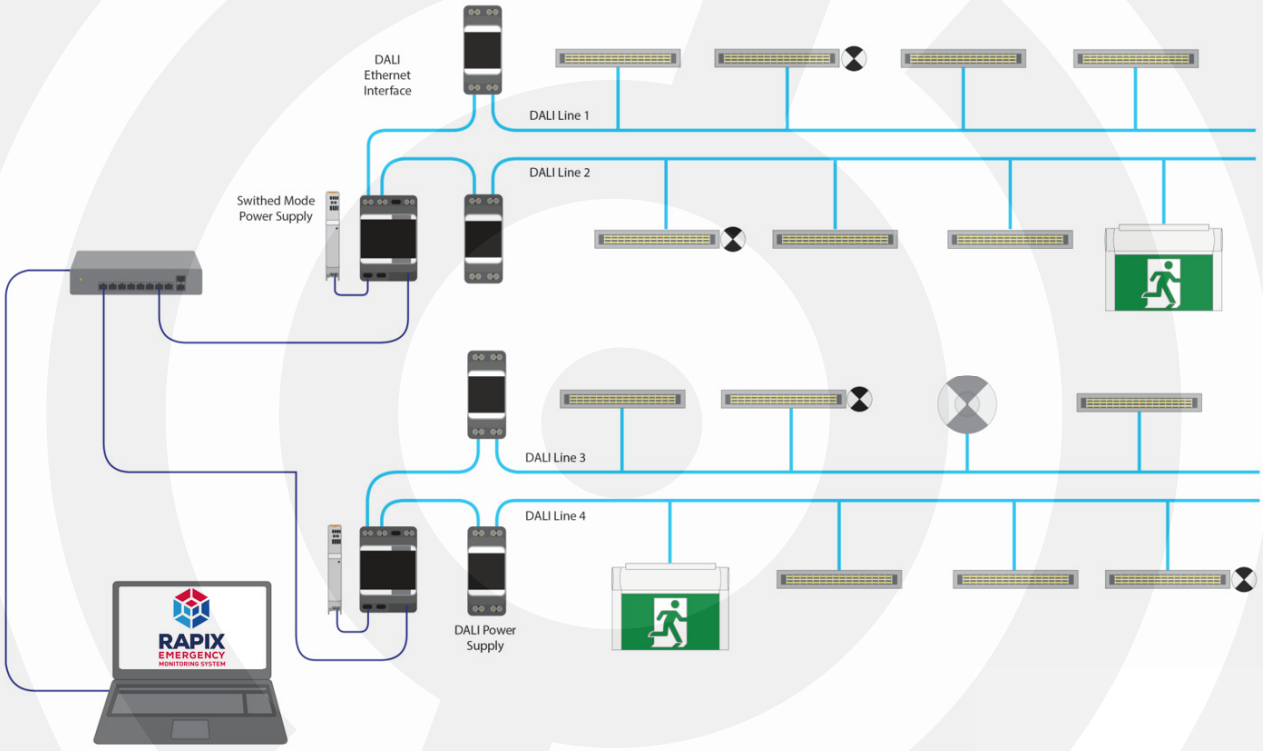
- Carries out all required testing regularly, reliably and cost effectively
- Maintains the hard copy documentation that AS2293 requires
- Automatically runs the Initial 120min Discharge Test
- Automatically runs the subsequent 90min Discharge Tests
- Automatically schedules the discharge tests at 6 monthly intervals
- Automatically creates PDF Test Reports detailing all Discharge Tests results
- Automatically creates PDF Repair Reports showing only failed EM Luminaires and why they failed – allowing maintenance action details to be signed off
- Automatically e-mails Test and Repair PDF Reports to Facility and Maintenance personnel
- Automatically alerts before a test takes place
- Automatically alerts if failed units have not been rectified in a timely manner

RAPIX Emergency Monitoring System Products

Product	Description
DALI Ethernet Interface 	Provides an isolated communication path between Ethernet and DALI. Control and monitoring of DALI enabled luminaires and DALI emergency lighting devices can be performed by a PC at any location with LAN connectivity (wired/wireless), including remote from the installation. Supports two DALI lines with 64 units per line
DALI Power Supply 	A single line, fully DALI compliant power supply. Each DALI Line in an installation requires a dedicated DALI power supply for correct operation of the DALI system. 100% DALI compliant.
Switch Mode Power Supply (for DALI Ethernet Interface) 	240Vac/12Vdc power supply units recommended for powering one or multiple Diginet DALI Ethernet Interface Devices. These units are not suitable for powering DALI lines, use Diginet DALI PSU part number DGLMPS01 for powering a DALI line.

Product	Description
Emergency Monitoring PC software 	Best in class software application for monitoring emergency lighting luminaires. RAPIX Emergency will allows the user to: • Perform one-click automatic commissioning and configuration of a DALI emergency system • Configure and run routine tests as required by the Australian Standard AS2293 for "Emergency escape lighting and exit signs for buildings" • Log events and create full test and maintenance repair reports in PDF format • Receive email notification of important events.

Typical RAPIX Emergency system architecture



More information on The RAPIX Emergency Monitoring System can be found here:
http://www.diginet.net.au/rapix-emergency-2/

Lighting Control Methods

The collection of control methods provided below can be achieved simply and quickly with the RAPIX Lighting Control System. The speed and simplicity with which these sometimes complex and certainly sophisticated regimes can be implemented is a key benefit of RAPIX Lighting Control System.

These are accumulative and not mutually exclusive - the more strategies which can be included, the larger the energy and costs savings. However balance between work comfort and productivity and energy and costs savings will have the maximum positive impact.

- Implementing too many methods will increase energy and costs savings but will be detrimental to the occupants, reduce productivity and in some cases people have been known to try and defeat and disable systems. The net result will be negative.
- Implementing too few methods reduces the system's ability to meet legislated building codes, the amount of energy saved and the comfort provided and extends the system payback periods to a stage where they are less financially viable.

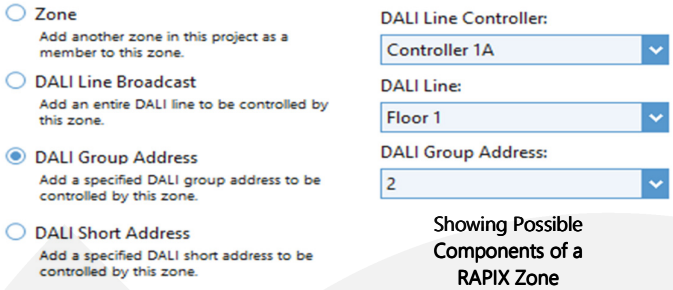
Your goal when designing these systems is to find a balance whilst serving your client's needs and adhering to the necessary standards. RAPIX Lighting Control System helps you achieve this more quickly and with less design complexity.

Table of Lighting Control Methods

Zone & Zoning Control (ZC)

Simple RAPIX method to create zones of lighting control at any scale to simplify control of DALI

A RAPIX Zone represents a virtual lighting zone, of any size, which can include a single DALI device through to a whole building and all connected lighting in that building.



Showing Possible Components of a RAPIX Zone

The greater number of lighting zones – controlling smaller groups of lights - which can be created, the greater the opportunities for energy and real cost savings associated with lighting.

This fine zoning capability also provides the user with more precise control of their environments adding to the levels of comfort provided.

This Zone function also easily permits cross DALI Line control, meaning that with the Zone virtual layer, where a DALI device, DALI Group or other Zone is located or which DALI Line it is on, does not affect a Zone Controller's ability to control the lighting.

The virtual lighting zones can be controlled with a single, simple Zone Scene command.

This Zone Scene command activates DALI scenes stored in DALI devices and/or DALI ARC power commands to individual DALI devices to create the desired lighting scene in that Zone. In this way a Zone's lighting circuits / DALI Groups / DALI devices can have multiple different lighting levels from a single Zone Scene command.

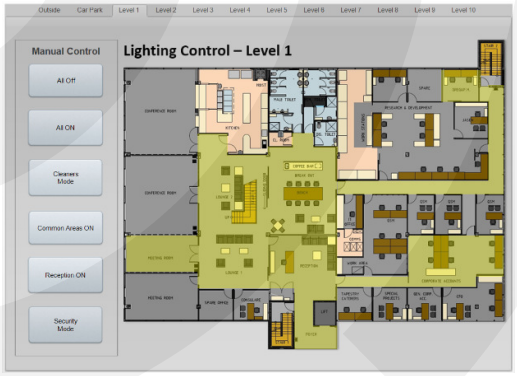
This means from a single zone scene message it is possible to control all cascading zones to any predetermined level per device, group or zone.

Example:

In an open plan office as in plan below, you may create a number of zones. When you need to control those zones, or any other zones within that zone, the RAPIX Zone Controller manages which lights are controlled.

There is no practical limitation on the number of zones which can be created.

Possible Zone Examples
1. Whole building 2. Whole floor 3. Reception 4. Corridors 5. Amenities 6. Kitchen 7. Open Office Space 8. Boardroom 9. Conference rooms



RAPIX Zones:

1. Helps engineers and contractors to simplify and change their design at any time in the design and construction process.
2. Enables floor plans to be divided into as many separate zones as in necessary to maximize energy savings in line with NABERS recommendations.
3. Makes future maintenance and floor re-configuration easy and inexpensive to execute.

Time Based Scheduling (TC)

Also known as time-clock control

Automatic activation and deactivation of lighting based on time of day, day of week etc. to save energy.

Implementing Time Based Scheduling strategies serves to save anywhere up to 50% of costs related to lighting energy and this is one of the most effective RAPIX Lighting Control Strategies which can be executed.

Time based scheduling is implemented from a Zone Controller which is capable of providing time based scheduling in chronological and astronomical variables.

Alternatively, the time scheduling can be implemented in the head end software GUI (Graphical User Interface) operating on a PC

Time schedules can be created based on a number of variables including:

- Time of day - hour, minute, second
- Day of the week
- Month of year
- Year
- Sunrise +/- offset
- Sunset +/- offset

Exceptions can be used where a particular time schedule can be created and at those times when an exception schedule is present, the time based schedule can be modified. Typical exceptions in Australia are public holidays such as Christmas and New Year. So a schedule may be set to occur every morning at 9:00 except on Christmas Day and New Year's Day.

Using these variables it is possible for the RAPIX Control System to:

1. Control any zone/s to go to a predetermined lighting scene at a predetermined time.
2. System state changes by modifying how system components and zones operate at different times, days, months.

Timing Examples

- Everyday @10:00
- Every Tuesday @10:00
- Every Tuesday, Thursday, Friday @ 10:00
- First Monday every month @10:00
- On Tuesday 16th April @10:00

When designing a RAPIX lighting control system typical time based schedules can include:

- Turning outside lighting on at sunset – or a predetermined time after/before sunset
- Turning outside lighting off at sunrise – or a predetermined time after/before sunrise
- Performing a building lighting shut down at a predetermined time of evening every Monday to Friday
- Activating the security lighting zone every evening at 22:00, Monday to Friday.

Using the timing variables available in this way it is possible for the RAPIX Lighting Control System to control the lighting when needed to provide maximum energy savings and occupant comfort.

On/Off Control (1-0)

Ability to manually turn lights on and off when desired to save energy and provide light when it is needed.

The RAPIX Lighting Control System includes a range of DALI Relay devices. These relay devices can be used to switch on and off a lighting circuit or other device which can be switched on and off.

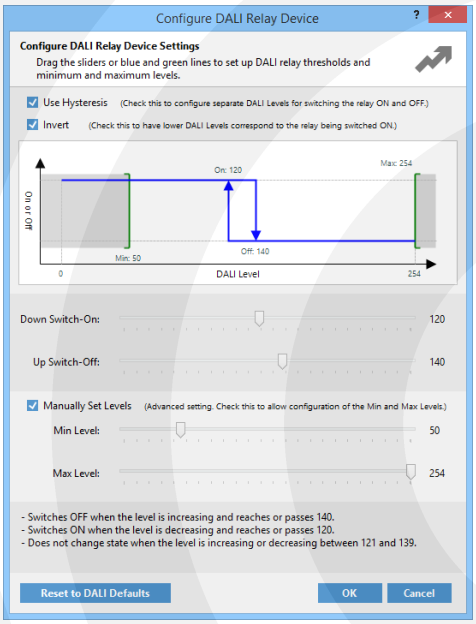
If a suitable DALI ballast or DALI driver cannot be sourced for the preferred lighting fixture or luminaire, it is still possible to control the individual light or the lighting circuit with 1 or more fixtures.

The simplest and most cost effective way to achieve this is via a DALI relay device. That is, a relay, which itself is controlled by a DALI signal. Lighting loads without DALI inputs are thus integrated into the DALI system.

These RAPIX DALI Relay devices are assigned a single DALI Short Address for each DALI relay. In this way the DALI Short Address can be assigned into groups with scenes the same as any other DALI compliant device.

Additionally the RAPIX DALI Relay devices can be programmed to switch on and switch off at different levels.

Multi-Level Switching Example



When integrating DALI Relays into a larger DALI system, that DALI system will typically be dimming from a level, to a level, with a fade time.

This fade time represents a constant speed at which the lighting will transition from 1 state to another. Go to 0 from 100 over 6 seconds for example.

Normally, any value over 0 in a relay is on and 0 is off. This means is that if I am dimming from 100% to 0% over 6 seconds, non-DALI devices connected to a relay will switch off when all other lighting switches off – when the dimming curve reaches 0 after 6 seconds.

Conversely if I want to dim from 0 to 100 over 6 seconds, as soon as the value is above 0, the relay will switch those non DALI luminaires on. This means that all my non DALI luminaires will go to 100% immediately, which is not always desirable.

RAPIX Lighting Control System has a solution to this issue.

In the pictured example the relay has been configured to:

- Switch ON when the level is increasing and reaches or passes 140
- Switch OFF when the level is decreasing and passes 120
- Will NOT change state between levels 121 and 139

These levels represent DALI ARC Power levels, not percentages.

This type of configuration flexibility can be useful and provides designers greater flexibility in setting scenes precisely as intended. It is also a method whereby timed switching of any device can be achieved simple. This is achieved simply sending a DALI fade time command and then identifying in the commissioning software where on that time-line I would like the device to activate.

Remember that because this is a relay, we can control an entire circuit of non-DALI devices, not just a single DALI device. This allows designers to leverage a single DALI address to control many luminaires as a group very cost effectively.

Top Set (TS)

Setting a maximum light level below the maximum output to automatically reduce possible energy consumption and save money.

Also known as trimming.

This strategy depends on the lighting design greatly and is used most effectively in over-lit spaces.

As the International Standard for Lighting Controls, DALI compliant drivers and ballasts (DALI control gear) allows a maximum level to be saved and recalled within the control gear itself.

This is a very simple, fast and effective way to save energy and reduce operating costs.

By setting the maximum output level below the maximum possible output, and thereby reducing the amount of energy required, a daily automatic energy savings can be realised. Of course if this top setting level is set too low to try and squeeze more energy savings, the required LUX may not be available to occupants which:

- May not meet building standards
- Could lead to poor productivity
- Possibly raise workplace safety concerns

Alternatively this top setting strategy can also be achieved at a control system level, where the control system is instructed NEVER to call a 100% light output scene. One example is that no user interfaces are programmed allowing a scene to be recalled which is equivalent to 100% output.

However, if for some reasons DALI control is lost, DALI will default to whatever is programmed as its maximum output level. This is part of DALI's redundancy protocol.

Dimming (D)

Reducing and increasing lighting output without switching the lights on or off.

Dimming can be used as an individual strategy or combined with a number of the other strategies detailed herein.

You dim lights down. You fade lights up.

As RAPIX Lighting Control System utilizes DALI it is possible to dim from 100% to 0.1% as per the DALI standard. This range of dimming depends on the DALI drivers and DALI ballasts being controlled, not the capability of RAPIX Lighting Control System.

In its simplest form, dimming allows the light output of selected luminaires or group of luminaires to be reduced without having to switch the lighting on and off- either automatically or manually by occupants. A typical example of this is in a meeting room or board room where the light being delivered is more, or less, than is required for the task at hand.

- Dimming down saves energy. With less light output comes a lower energy requirement.
- Dimming down reduces heat output from luminaires. This can have a life extension impact on the dimmed luminaire, especially with LED and halogen light sources.
- Dimming allows occupants to create a light level which is comfortable to them, increasing comfort and positively impacting productivity.

By dimming luminaires rather than switching them on and off, a number of additional benefits beyond energy savings are achieved.

1. Switching lights on and off causes more stress and could prematurely cause luminaires to fail due to exceeding duty cycles of drivers, ballasts and other electronic components.
2. Dimming, when done correctly, is less noticeable and therefore causes less interruption to occupants, especially when it is done automatically from a lighting control system.
3. Dimming keeps spaces illuminated, even at low levels, which provides a greater sense of well-being and comfort in an office space. No one likes to walk into a dark space.

Occupancy Detection (OD)

Using sensors to provide light only when light is needed – when humans are detected in the space.

Also known as Motion detection/sensing; Vacancy detection

Occupancy detection is a strategy focused on saving energy and in Australia forms a key part of NCC – National Construction Codes - (BCA) for savings energy associated with lighting.

In its simplest form when an occupancy detector or sensor, senses occupancy of a space it will turn on lighting for that space. When no occupancy is detected the lights are turned off. In this way, light is provided when light is needed.

These sensing technologies used to perform this function vary from PIR (Passive Infra-Red – Heat sensing) through to dual technology sensing with Microphonic detection (sound sensing), with a range of other detection and sensing methods available, each with their pros and cons.

However, **Occupancy Detection (OD)** differs from motion detection. Whilst the initial detection of movement and/or motion is typically the same, occupancy detection refers to the ability to determine if people continue to occupy the space.

Occupancy Detection therefore requires more highly tuned sensing devices and can provide for greater energy savings as a result. For example the ability to determine if a person is occupying a space if they are not moving a lot – such as when typing on a keyboard or reading – requires the ability to detect either fine movement or sound at a far more detailed level compared to when someone walks through an area.

Occupancy Detection is often combined with **Dimming** strategies. For example when occupancy is no longer detected, rather than switching the lights off, the RAPIX Lighting Control System will dim the lighting to the predetermined level to save energy and maintain legislated lux levels for the particular space.

An alternate strategy is when occupancy has not been detected for a period of time the lighting can be dimmed to a lower level first, say for 5 minutes. If no occupancy is detected during the 'grace' or 'dwell' period of 5 minutes then the lighting control system automatically extinguishes the lighting.

Vacancy Detection is a variation of Occupancy Detection. Typically **Vacancy Detection** is used where the occupant has the choice to turn the lights on in the zone of detection, rather than automatically turning the lights on when occupancy is detected. This is best used in smaller office spaces where everyone in that area is engaged in the same activity.

Vacancy detection also works best in spaces which receive a lot of natural light and can provide further costs savings as individuals choose not to turn lights on unless they deem it necessary.

Once the lights are activated the sensing devices check for occupancy – or the lack thereof – and when the zone is vacant the lighting will turn off or alternatively dim the lighting as described in the alternate occupancy strategy detailed above.

Day Lighting (DL)

Also known as Daylight Harvesting

Utilising natural light to decrease artificial light output to save energy.

Day Lighting is an energy saving strategy focused on utilizing the natural light coming into a space, to reduce the amount of artificial lighting needed, to provide the mandated lux levels in office spaces.

Commonly **Day Lighting (DL)** is used in office spaces which feature large external glassed walls where natural light is available.

Therefore **Day Lighting** provides the best Return on Investment (ROI) in areas where a lot of natural daylight is naturally occurring. In Australia this often means that more energy can be saved during summer than during winter due to longer days and the sun higher in the sky.

A typical application has the two rows of perimeter luminaires closest to these large glassed walls and windows controlled from a PE (Photo Electric) sensor, which measures the quantity of reflected light in the space. The **Day Lighting** function then Dims the controlled luminaire or luminaire groups so that the target lux level is maintained, saving energy.

> In some circumstances when a natural light threshold is reached these perimeters rows are switched off, however this is not recommended in a typical office space due to the disruption to the occupants and the dissatisfaction associated with having the lights off.

There are open loop and closed loop variants of this control

Closed Loop means the light sensor is located within the space that is being controlled and is continuously measuring the level of reflected light based on the commands it is issuing and changes it is therefore making. In this way it is measuring and reacting to its own instructions in a closed loop function to maintain a target Lux level.

This is more complex and more time consuming to fine tune during commissioning to achieve the energy savings result needed and should be nominated sparingly.

Open Loop means the sensor is often outside the space which it is controlling and upon measurement of natural light, affects a change to the area to reduce or increase electric lighting to maintain a target Lux level. In this way it does not know what is happening in the space and is reacting to outside stimuli to issue dimming commands.

Whilst not as accurate as closed loop in providing a finely tuned energy saving system, by working with a number of bands of lighting thresholds, energy savings can be achieved and this method is able to be commissioned significantly faster to achieve similar energy saving results.

Each control method has it benefits in different applications and Day Lighting is also often combined with other strategies such as Dimming and Occupancy Detection. The question to ask when choosing which method to apply or whether to utilise Day Lighting at all is:

"For those areas which are nominated as being controlled with Day Lighting, what is the calculated energy savings from that strategy for the life of the system?"

With some systems, the resources needed to install and commission the Day Lighting methods are significant and whilst they will certainly save energy, the energy saved may not allow for a solid ROI business case. Using Day Lighting as one of many strategies and combining it with others can add to the overall energy saved and provide sanity to these ROI calculations.

Scene Setting Manual Control (SS)

Creation of lighting scenes for particular applications and activities which controls one or more circuits or light points simultaneously.

Scene Setting (SS) provides both the ability for occupants to select a scene to suit the task or activity and for the RAPIX Lighting Control System to automatically select a scene based on the time of day, on receipt of inputs from other systems such as access control or FIP (Fire Indication Panels) or in response to a connected sensor instruction.

Scene Setting is a fundamental application of any lighting control system to provide simplified control of multiple circuits or groups of lighting.

Typically the terminology of **Scene Setting** applies to the action of controlling more than 1 luminaire or more than 1 group of luminaires simultaneously. Additionally part of this scene setting would set those luminaires or groups of luminaires to different levels.

As part of this Scene Setting process it is possible to define a fade time. That is, what length of time is desired for the lighting to fade from one level to another – from the current scene to the desired scene.

For example we may have 4 groups of lights, labelled as Group 1-4 in the pictograph below. When each scene is selected – either manually or automatically - the controlled groups can each be set to a different lighting output level simultaneously – creating a lighting scene.

SCENE #	LIGHTING GROUP 1	LIGHTING GROUP 2	LIGHTING GROUP 3	LIGHTING GROUP 4
SCENE 1 ALL ON	100%	100%	100%	100%
SCENE 2 PRESENTATION	100%	0%	50%	66%
SCENE 3 DISCUSSION	0%	100%	30%	0%
SCENE 4 ALL OFF	0%	0%	0%	0%

However Scene Setting can equally be used to describe controlling a single group of lighting to a lighting level.

For example as DALI can be controlled in a broadcast mode, where all connected DALI devices respond the same, a scene could be broadcast to set an entire DALI Line to a scene.

Importantly whilst RAPIX Lighting Control System fully complies with the DALI standard so far as 16 groups of control and 16 scenes per group, it is possible to provide more than 16 scenes and control more than 16 groups through the use of RAPIX Zones.

> Additionally whilst DALI defines a range of fade times as RAPIX adheres to all of these as DALI compliant, using RAPIX the fade time which users desire when **Scene Setting** are far more variable and not limited to DALI fade rates only. These RAPIX 'Xienes' provide greater functionality to meet the exact needs of users without compromising on DALI Compliance.

Using RAPIX Zones and Xienes are therefore preferred in RAPIX installations which include Zone Controllers.

Task Tuning (TT)

Ability to adjust the scene setting to a particular task rather than a general scene light level.

Task tuning shares common attributes with Dimming and Scene setting and provides further tuning for the task at hand beyond what can be achieved with these other strategies independently.

Importantly as the RAPIX Lighting Control System features a digital rotary encoder, setting an exact lighting level or light colour for a particular activity is easily achieved.

Task tuning is something which needs to be encouraged to ensure maximum productivity and utility is leveraged from the RAPIX Lighting Control System.

Diginet recommends a change management program for new employees - and for entire offices if they are moving into a newly designed space - with a RAPIX Lighting Control System installed.

The majority of office workers do not understand the importance of being able to set the right light level and light colour. Neither do they understand the impact this can have on their mood, quality and quantity of work. This can have a direct impact on their satisfaction with their working life and to the value they bring to the company.

When new tenants occupy a new office, their previous office environments often provided no feasible way to interact with the lighting in their space beyond on and off. When provided this capability, ensuring an understanding of how and why the RAPIX Lighting Control System has been installed can encourage interaction and participation.

Advanced Control Methods

Constant Light Output (CLO)

The Constant Light Output (CLO) functionality compensates for light loss associated with operating hours, ensuring that dimmable DALI Luminaires deliver the necessary light level throughout the duration of its operating life.

Also known as Constant Lumen Output, Lifetime Lumen Management

Over the life of a luminaire the uniformity and intensity of lumen output from the light source deteriorates. At the end of its operational life a luminaire typically has experienced lumen depreciation.

This CLO operation assumes that to achieve the required lighting level, in an office space for example, that the lighting design has been created to deliver that output level day 1, the luminaire will be driven to its maximum. Over time the same amount of power will deliver less light output as the light source degrades. Hence lighting designs are often over lit to begin, consuming more energy than is needed and more light than is wanted.

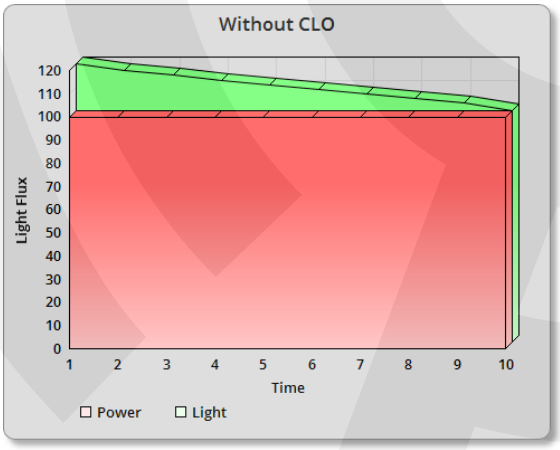
The ideal result from CLO is to ensure lighting uniformity and intensity throughout the lumen depreciation period.

Constant Light Output theory suggests that it is better to design a space to be over lit on day 1. But by using RAPIX Lighting Control System the luminaires can be dimmed to achieve the target lux level so the space is not over lit.

This initial action of dimming achieves 2 energy savings and longevity goals in one application.

1. By dimming the luminaire less power is delivered as less power is required to achieve the desired lux level, saving energy and money.
2. This has the additional effect of putting less stress on electrical components, generates less heat, potentially extending the rated life of the luminaire.

Then, over time using the RAPIX Lighting Control System, as the lumen depreciation occurs, the amount of power delivered is automatically increased to achieve the desired lumen output.



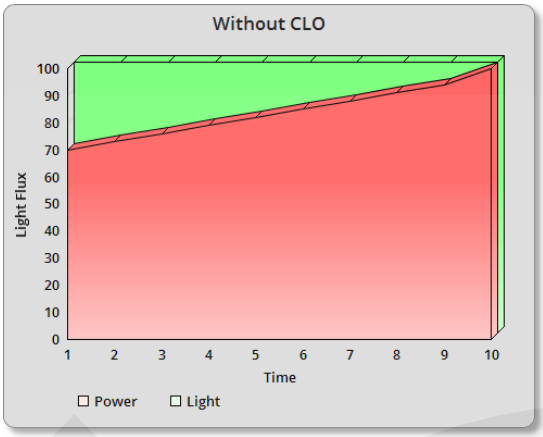
The net effect of CLO is theorised to provide a lower Total Cost of Ownership (TCO) as less energy is used to begin and the luminaires last longer. This savings offsets the increased initial capital expenditure.

This represents a typical over lit space.

The green area is wasted energy of an over-lit space.

Lighting Design provides more light than is needed day 1 to ensure that at end of luminaire's operational life, lumen output is acceptable.

The green area represents lumen depreciation in a linear manner which may or may not be correct depending on the exact products used.



This represents CLO in action.

The initial power required to achieve the mandated lux level is far lower than what is needed at the end of the luminaires life.

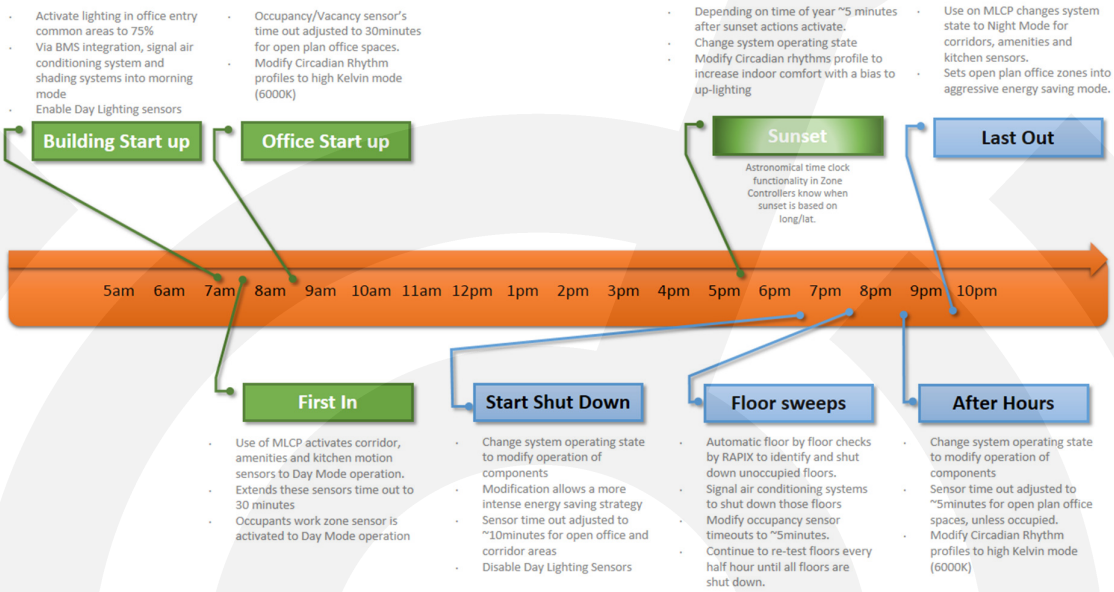
In this example the exposed green section represents energy and money saved.

As lumen depreciation occurs, the RAPIX Lighting Control System delivers more power to the drivers to increase lumen output to achieve the mandated lux level in the office space.

First In/Last Out (FILO)

Control logic to save energy which defines and controls how lighting and other services are affected by the 1st occupant and the last occupant in the space.

This is a sophisticated lighting control method and one which requires an understanding of how the entire office space is to be used, which technologies are being implemented and what other systems the lighting control system may be interfaced with.



First In / Last Out Operation as Part of the Automated Ebb and Flow of the Building

For Example:

An open office plan has a master wall switch at the entry to the office - such as a lift foyer or reception area. The installed RAPIX Lighting Control System has sensors installed in the open office areas to meet BCA requirements.

It also has sensors in all meeting rooms and boardrooms, an embedded time clock in the Zone Controllers to provide some Shut Down / Start Up Sweeps (SSS) and time based logical gates.

First In Operation

- The time clock issues a command at 8:30am which activates the sensors in the open office areas. Prior to this the sensors could be disabled. Office areas sensors remain active all the time.
- When an occupant arrives before 8:30 they use the master wall switch to activate their zone. With this zone activation the corridor sensors, amenity sensors and kitchen sensor are activated too. The other zone sensors remain inactive.
- In this way, when the FIRST IN person enters the space the entry pathways and essential services are activated when their associated sensors detect motion.
- Also, only the sensor in the manually activated working zone is activated to detect motion.
- The other working zone sensors are disabled so as the occupant enters and walks through or past these zones, these zones do not illuminate.
- After 8:30 the system changes state and activates all sensors, all the time until shut down.

An alternate to this scenario is to NOT disable the sensors at all but instead modify the sensor time out period based on time of day (system state).

In this way the occupants can simply enter the space without pressing any buttons and the system will automatically operate the lighting for a safe pathway to their working zone.

However, as the time-out period will be shorter in the After Hours state – say ~5 minutes timeout instead of ~30minutes timeout – even though the open plan zones will illuminate as the FIRST IN occupant walks to their lighting zone, they will extinguish faster than during normal business hours.

This can be seen in the diagram above. At 8:30 the system state is changed and the sensors time out period is swapped to 30 minutes. This automates a great energy saving automatically without any human intervention required.

Last Out Operation

The Last Out operation is essentially the reverse operation of the First In and is focused on System state changes to maximise energy savings without forgoing occupant comfort. If employees choose to stay back to get work done, providing a suitable work environment during this period is critical.

- It is assumed that a floor by floor sweep has occurred to identify floors which can be shut down and which are still occupied.
- When an occupant is the Last Out after 8:30pm they use the master wall switch to de-activate their zone.
- With this zone de-activation the corridor sensors, amenity sensors and kitchen sensor are de-activated too.
- In this way, when the LAST OUT person exits the space, the floor is put into its after-hours state automatically by activating the floor shut down sequence.
- After 8:30 the system changes state and de-activates all sensors, all the time until building Start Up.
- The alternate method for FIRST IN can likewise be applied to LAST OUT. Instead of disabling sensor, the sensor time out profile can be automatically modified to perform more aggressively.

These previous examples have focused on control of lighting only. It is possible to control any number of connected systems such as AV systems, HVAC, blinds and shading systems for example as part of these First In/ Last Out (FILO) scenarios too.

After Hours Security Walk Through (AFS)

A special scene focused on saving energy without inhibiting building security.

A special RAPIX Lighting Control scene focused on saving energy without inhibiting building security.

During an after-hours event, whilst security personnel are undertaking their floor walk-through rounds, a special button is provided on the floor wall switch which enables the RAPIX Lighting Control System to illuminate the space at a level to allow a security inspection and safe pedestrian activity.

Typically this Security Walk Through scene:

1. Does not activate all lighting in the space
2. Provides lighting for a short period of time prior to reverting back to the space's standby lighting level
3. Does not activate any connected HVAC systems that may be interfaced with lighting

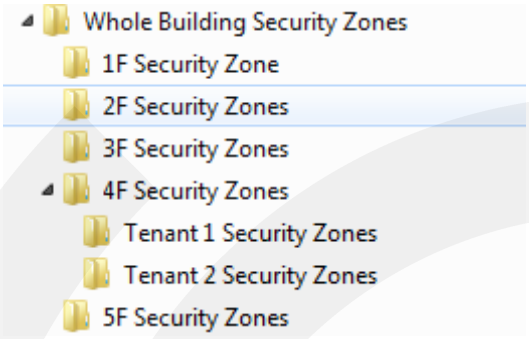
This single wall switch button is deactivated during normal business hours. When the System Operating State is transitioned to an After Hours mode, the wall switch button which provides this functionality is enabled.

Security Lighting (SL)

Allocating lights or zones as security lights for after-hours illumination or for security events, ensuring sufficient lighting is provided.

There may be a desire to ensure that an each office floor in a building has a very low level of security lighting, when the building is shut down.

This can provide the first people to arrive in the morning sufficient light to enter safely. Security lighting is also used for security patrols, again to ensure they have sufficient lighting to safely enter a space.



With the RAPIX Lighting Control System this is a simple matter of creating security zones. These security zones would include:

- a collection of individual DALI Short Addresses or
- a DALI Group, which has been pre-defined as the security group.
- A RAPIX zone already defined.

In this way a multi-layered security zoning topology can be created. This has the advantage of easily being able to activate all security lighting in an entire building from a single command.

Alternatively if a building shut down sequence occurs and some floors are still occupied and hence their security lighting scene is not activated, when those floors are shut down individual floor security zones can be activated simply at a granular level.

After Hours Cleaners (AHC)

A special scene focused on energy savings without inhibiting the cleaner's ability to do the job correctly.

A cleaner's function is a special RAPIX Lighting Control scene focused on saving energy without inhibiting the cleaners from performing their jobs.

After hours, when the cleaners arrive to undertake their duties, a special button is provided on wall panels on each floor which when pressed provides a lighting level for a pre-determined amount of time.

The lighting level will typically be less than the normal operating lighting level, providing energy savings. The system will then automatically switch back to its previous state after short pre-determined time – whether that be off or to a security lighting level.

Importantly the lighting level should be sufficient to enable correct performance of cleaning duties and should remain on for a typical time so the cleaners don't have to rush through and miss cleaning areas.

This single wall switch button is deactivated during normal business hours. When the System Operating State is transitioned to an After Hours mode, the wall switch button which provides this functionality is enabled.

Advanced Method

A more advanced method is to provide the cleaners button and link it with the occupancy or motion detectors, if installed. During the time when the cleaner's button is active the motion sensors will provide lighting, to a pre-determined cleaning level for a predetermined time.

In this way the sensors will automatically extinguish the lighting when the cleaners have finished in an area. As the sensor time-out period is shorter than during normal business hours, lighting is provided only in the areas where the cleaner is present rather than the entire floor.

When not in cleaning mode the sensors will operate in the predetermined fashion.

Load Shed (LS)

In the event of a black-out or brown out the ability to set the system into a low energy consumption state to reduce stress on generators or during high cost tariff periods.

In the event of a black-out or brown out – or during high cost tariff periods – the ability to control the RAPIX lighting control system into a low energy consumption state to reduce stress on generators and ensure base egress lighting requirements are maintained.

Typically a simple interface message activates a LOAD SHED scene in the RAPIX Lighting Control System, to extinguish some lights, dim other lighting zones to lower levels and maintain lighting in essential zones, whilst limiting lighting in non-essential zones.

Different load shed states can be activated depending on the type of event and there is no limitation of how many zones or states can be defined.

That is, whether it's in response to an electricity incident or due to an energy savings tariff strategy the RAPIX Lighting Control System can be transformed into the correct state.

There is no need to send the entire system into a Load Shed state. This can be achieved on a tenant by tenant, floor by floor selection process as is needed to meet the client's needs.

Room Joins (RJ)

For use in meeting rooms, conference rooms and ball rooms with moveable walls to allow rooms which become 1 space to be controlled as 1 space automatically.

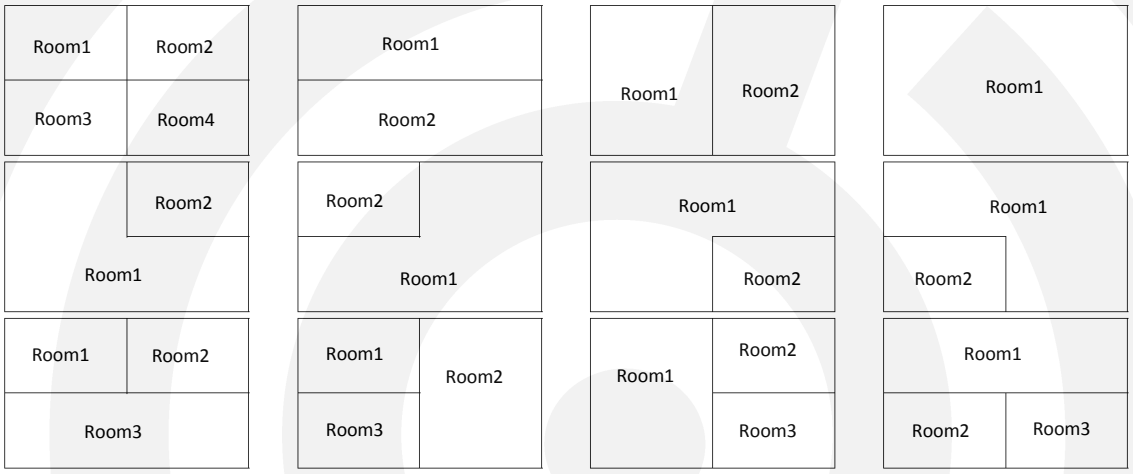
Typically found in offices, hotels and conference centres, the ability to control multiple rooms as 1 is a powerful method to simplify lighting control for end users.

The RAPIX Lighting Control System provides a straight forward template approach to achieve the joining of multiple rooms.

When room dividers are closed the desire is to a have a wall switch in that room which controls only the lights in that room.

However, when dividers are removed to create a larger space, the intent is to allow any of the control panels in that room, control the entire space as 1, from any of the wall switches.

For example here is a typical 4 room join and the various configurations which can be provided.



Because of the large number of variations from just 4 rooms, when designing Room Joins a thorough understanding of both the client's needs and the time required to achieve those desired results is necessary. Asking for every possible variation as part of a design, when they're unlikely to ever be used, is a waste of time and money in system commissioning.

RAPIX Zones

The zoning capabilities integral to the RAPIX Zone Controllers simplifies this operation further.

As we are using DALI, this room join functionality can be achieved simply by creating a set of DALI Groups which encompass each of these control scenarios. It is then a simple matter of recalling that DALI Group scene from the wall switch.

The wall switch button operating state is managed by RAPIX with Operating State changes either from dry contact inputs from micro-switches connected to an eHub or directly via a wall switch button which toggles the systems state.

In this way, we use DALI to define the different groups of control and RAPIX to manage the button functionality.

If the rooms has multiple DALI Lines servicing the lighting the RAPIX Zones controllers manage the control across DALI Lines and/or Zone Controllers whilst using DALI's core functionality to crate groups of control.

After Hours Extension (AHE)

Energy saving technique providing occupants the ability to light their area with associated amenities and egress without keeping a whole building lit.

After hours extension is an energy saving technique focused on providing occupants the ability to light their area – with associated amenities and egress – without keeping a whole building lit.

Typically a simple After Hours lighting button is provided which will provide lighting after the normal building shut down sequence has occurred.

In this way energy savings is maximised as an entire building or tenancy is not lit. Only the area and associated egress paths and amenities remain illuminated, whilst the remainder of the lighting is off or in its standby state.

This RAPIX Lighting Control Strategy provides flexibility in the timing used.

That is, for how long will After Hours lighting be provided. Typically by pressing the After Hours Lighting button the occupant is provided between 1 to 2 hours additional lighting on their floor or office tenancy.

At the end of the lighting extension a warning is given, such as dimming or flashing the lights. This provides the occupant time to press the After Hours button for more time.

However if the button is not pressed then the RAPIX Lighting Control System will run its floor shut down sequence and move state into its normal after hours mode to ensure maximum energy savings energy savings.

This single wall switch button is deactivated during normal business hours. When the System Operating State is transitioned to an After Hours mode, the wall switch button which provides this functionality is enabled.

Corridor Hold Off (CHO)

Also known as corridor linking

Focused on saving energy, a technique to ensure occupant egress routes remain illuminated if they are linked to their office or workspace after hours.

This is a RAPIX Lighting Control Strategy focused on savings energy whilst balancing occupant comfort, especially after hours in office spaces.

The DALI lighting control system is configured in such a way to ensure that if occupants are working after hours, that not only does the lighting in their zone remain on, the egress pathways -corridors – and sometimes amenities also remain illuminated.

In this way the lighting is only provided where light is needed and egress pathways remain lit so the occupants can safely exit, whether that be during an emergency event or in the course of finishing work for the day.

When their work zone is extinguished as they no longer occupy that space, the associated corridors can also be switched off or dimmed automatically by the RAPIX Lighting Control System.

Of course the corridor hold off can be linked to multiple zones (having multiple dependencies).

In this way even if 1 occupant leaves an office, if there are other offices that remain occupied with the same corridor dependency, the corridor will remain illuminated for those occupants still present.

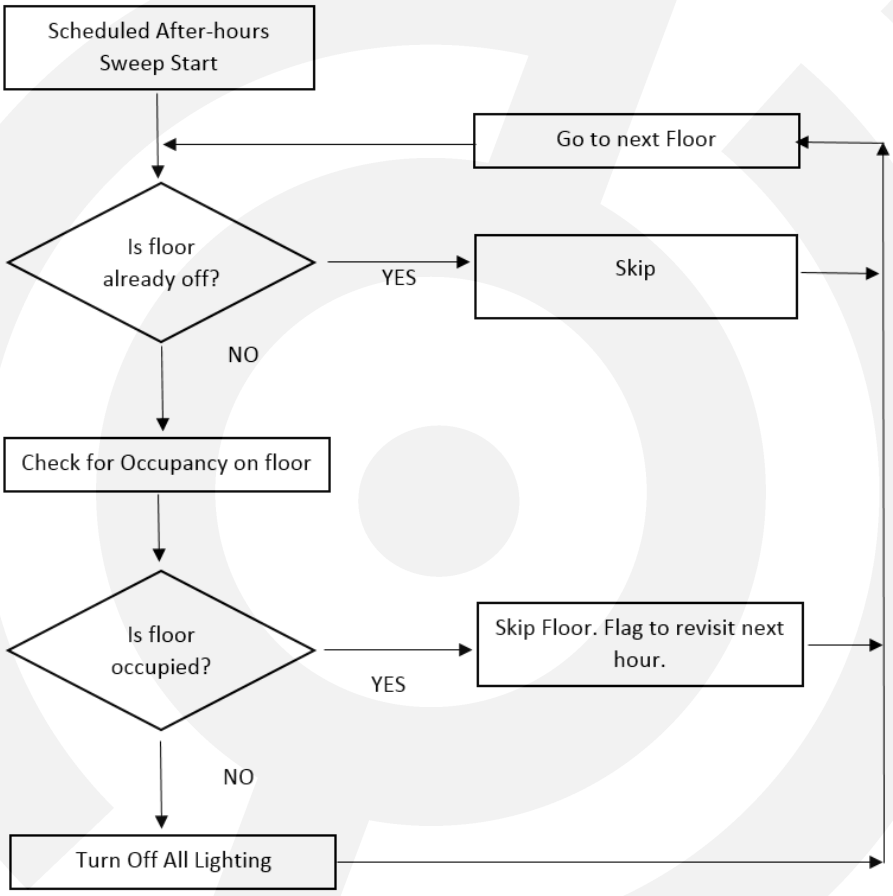
Shut Down Sweeps (SDS)

Typically used with TC functions, focused on saving energy after hours by sweeping floors and turning them off when no occupancy is detected.

This strategy ensures that everything from a single floor to an entire building is not illuminated after hours if no-one is present.

Whilst it is possible to simply turn off all lighting in a building from a single command this is not practical. People tend to work late and variable start and finish times are becoming more popular in the modern workforce and flexibility is key. If employees are prepared to work late or after hours these staff should be just as comfortable as employees working during 'normal' business hours.

This strategy considers each floor as a separate 'case', evaluating the needs of each floor based on its current status – on/off/ occupied. This is expressed visually in the flow chart below.



Note that this routine is simplified and does not consider other strategies such as after-hours extension for example. The routine can be modified to include a number of other strategies.

This routine repeats every hour until all the floors are off.

The routine could also continue to run all night, every hour. What if someone comes in each night at 10pm to collect their car keys after 'entertaining in the city'? If this person came in after the sweep had occurred the lighting on that floor may remain on all night.

APPENDIX 1

What is DALI and Why Do We Use It?

The RAPIX Lighting Control System has its foundation in DALI as a basis for standardising lighting control design, operation and feature set. Whilst this is our foundation we have expanded on this standard functionality to provide further flexibility and simplicity in capability, functionality and maintenance.

Below are the ABC's of DALI

International Standard for Lighting Control

DALI is the International Standard for Lighting Control (IEC62386). Recently the DALI 2 standard has been released which includes standards for control gear and backwards compatibility to the original standard.

Due to the growth of LED, the increasing demand for energy saving and growing awareness of lighting control systems, DALI has become more important than ever before. Today, with almost 120 international members, DALI is a global, international standard for professional digital lighting and therefore worldwide registered trademark.

Devices complying with the standard are interoperable at the DALI level, allowing devices from multiple manufacturers to operate correctly within the same DALI system.

All RAPIX Lighting Control System hardware is fully DALI compliant

Simple Wiring + Roust Communication

In the simplest systems, no configuration is required. Devices can work "out of the box".

Separate control cables are not required for each device – a simple 2-wire cable can be used to connect together all the DALI devices in a system. Daisy-chain and spurs are allowed. Bus-powered devices can be powered from the same 2-wire DALI cable that carries the communications information.

This simple wiring reduces installation costs, eliminates the possibility of wiring errors and makes for a straight forward installation process with a single cabling practice to remove complexity.

The digital protocol allows robust communication even with low-cost cable, and with most devices being polarity insensitive, mistakes in wiring are reduced.

Scalability & Flexibility

A small system could comprise of a single luminaire with control gear to drive the lamp, and a control device such as a sensor. In larger systems, each DALI system can become a subnet of a building-wide network and connect with a BMS (Building Management System).

Re-configuration of the DALI devices avoids the need to move devices or touch the wiring when the use of space in a building is changed.

DALI Compliance & Testing Regime

The DALI test system helps manufacturers ensure their DALI compliant products will have the highest levels of interoperability with other compliant products. Testing can be done either by an approved test house or by DALI members themselves.

Coupled with an updated compliance mark, this will helps support and promote interoperability of DALI devices and common lighting control platform.

Energy and cost-saving

With dimming control of individual light sources, as well as control systems that could include presence detectors, light sensors and scheduling, use of the lighting can be optimised for energy saving.

Implementing DALI in products is low-cost.

With luminaires widely available with DALI capability, and DALI device standardisation now executed, direct control from DALI devices to luminaires avoids the need to convert between other protocols.

Source DALI AG: http://www.dali-ag.org/discover-dali/dali-2-the-new-version.html

APPENDIX 2

DALI Compliance vs DALI Compatible

As DALI is a standard, compliance to that standard ensures protection for stakeholders at all levels. Once installed, compliant equipment can be communicated to and replaced with any other complaint product from any vendor.

This ensure stakeholders are not locked into custom products with custom protocols sold by single vendors to achieve their lighting control requirements and can choose another vendor at any time with the peace of mind that they system will continue to operate as required when DALI compliant products are installed.

However, there are many products in the market that claim to be DALI which are not fully DALI compliant. These can be referred to as DALI compatible in as much as they are compatible with some of the DALI functionality and operational standards, but not all of them. Therefore they are NOT DALI COMPLIANT and cannot be depended upon from a standards perspective.

This non-compliance causes issues for buildings owners, property developers and systems integrators when trying to execute lighting control strategies based on the DALI standard as these devices, which are only compatible and not compliant, refuse or simply are unable to operate as directed and as determined by the DALI standard.

DALI Compliance is achieved through a regimented testing process and apparatus which means those products which pass the regimented test can carry the DALI logo.

DALI Compliance – What to Look For?

1. DALI logo on device and then
2. Products are listed on DALI AG website and then
3. Can produce DALI test reports, DALI Membership documents on request

All RAPIX Lighting Control System Hardware is Fully DALI Compliant

Visit the DALI AG website and view all of the RAPIX Lighting Control DALI certification:

http://www.dali-ag.org/products/producer.html?tx_mmdali_producer%5Bproducer%5D=36&tx_mmdali_producer%5Baction%5D=show&tx_mmdali_producer%5Bcontroller%5D=Producer&cHash=8fcc563d74b7f1579b34e095c0de412d

APPENDIX 3

Online Resources

Table of additional online resources

Resources	Where to access
RAPIX Lighting Control System	Get product datasheets, installation manuals, learn more: http://www.diginet.net.au/rapix/rapix-system-details/
RAPIX Emergency Monitored System	Read about it: http://www.diginet.net.au/rapix-emergency-2/ Download Software: http://www.diginet.net.au/software-downloads/ Download Manual: http://www.diginet.net.au/downloads/RapixEmergencyDali/RapixEmergencyManual.pdf
RAPIX Addressing	Read about it: http://www.diginet.net.au/rapix-addressing/ Download Free Software: http://www.diginet.net.au/software-downloads/ Download Manual: http://www.diginet.net.au/downloads/RapixAddressing/RapixAddressingManual.pdf
Engineers Specification	Download RAPIX Lighting Control Engineers Specification: http://www.diginet.net.au/go/getspecification/
RAPIX CAD blocks	Download CAD Blocks: http://www.diginet.net.au/go/cadblocks/
RAPIX System Diagrams	Download System Diagrams:http://www.diginet.net.au/rapix/rapix-diagrams/

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