iR-TEC
Specializing in Building Sensors

OSNET

A Simpler and Smarter Wireless Lighting Control Solution

Design & Application Guide

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This document is prepared as general design and application guide for professional lighting designers. IR-TEC reserves the right to revise the contents without prior notice.

1. Understanding the OS-NET

1.1 Introduction

For decades, bringing smart controls to commercial or industrial lighting typically meant extra sets of control wire networking to every luminaire, labor intensive installation and wiring connection among complex system devices, luminaires and central controls, complicated configuration and system commissioning through proprietary management software. All above result in more time up and down the ladder, separate wiring diagrams, high levels of complexity, and higher project and maintenance costs. Even with the availability of advanced wireless technologies that can eliminate the wire networking of control wires, the design and installation of wireless lighting control are still challenges that require learning new techniques, installing extra equipment and executing complicated commissioning.

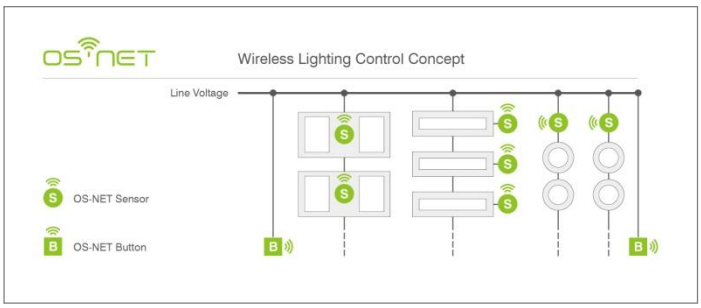
Undoubtedly, wireless communication technology will be the only cost effective solution to enable all non-residential buildings with "smart control". To be able to achieve that, a wireless mesh network has to be deployed within the environments so that it can transmit, receive, and forward all the control commands and data.

The OS-NET is an innovative solution that can easily enable general luminaires and lighting circuits with smart sensing control and wireless connectivity. OS-NET can also be referred as an occupancy sensor based wireless mesh network which is simultaneously deployed through installing the OS-NET enabled luminaires and lighting circuits.

Revolutionary concepts combined with numerous technological and design innovations have delivered unsurpassed level of Flexibility, Functionality, and Simplicity to the OS-NET. With amazing capability of the OS-NET solution, planning and designing a top-notch smart lighting system with sophisticated, human-centric, code-compliant sensing and control functionalities will be same as allocating the conventional luminaires and occupancy sensors.

1.2 How does OS-NET work?

OS-NET is created from a simple and cost effective concept, i.e. simultaneously deploy a wireless mesh network required for smart lighting control while installing the luminaires and lighting circuits with OS-NET Sensors integrated. Through the process of grouping all OS-NET devices, mainly the OS-NET Sensors, an OS-NET that can link up to 250 control groups thus created. Every OS-NET Sensor is capable of sensing the presence of an occupant or vehicle and the ambient light level within its coverage, and then executing a variety of code-compliant smart controls to the connected lighting of the group in a unique operation principle, i.e. individual sensing control, group activation.



"Individual sensing and control, group activation" means that every grouped sensor will detect occupant's activities within its coverage. When any sensor detects the presence of occupant or vehicle, it not only controls the connected lighting as set, but also broadcasts the occupancy signal to other sensors of the group to activate the programmed controls to the connected lightings. If any grouped sensor detects occupancy before delay time elapses, the entire lighting group will remain controlled as occupied. After the area is vacated and delay time elapsed, each grouped sensor will individually control the connected lighting as set.

1.3 OS-NET Devices

OS-NET devices mainly refer to the OS-NET Sensors and OS-NET Buttons. These are network devices featuring total functionality and wireless networking capability for smart lighting control. In addition to the individual functionality, every OS-NET device is also a network node that can transmit, receive, and/or forward the communication commands within the wireless network.

- OS-NET Sensor (ONS)

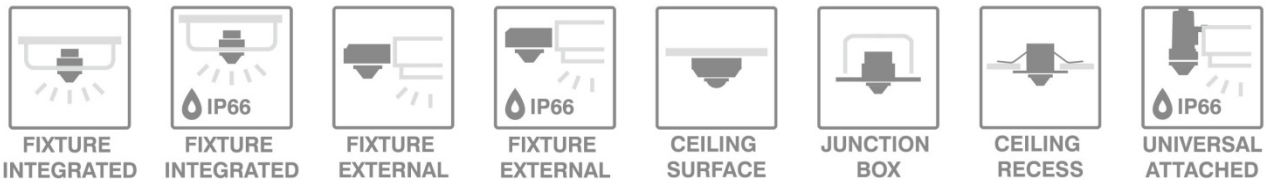
The OS-NET Sensors are fundamental devices that constitute an OS-NET mesh network. In other words, OS-NET is a wireless mesh network formed by a number of OS-NET Sensors. Every ONS is a perfect combination of occupancy sensor, daylight sensor, lighting control processor, and wireless communicator.

The ONS not only provides fully programmable smart control to the connected lighting by sensing the local occupancy status and ambient light level, but also broadcasts the occupancy signal to other OS-NET Sensors of the group to activate the respective controls as set through wireless network. OS-NET Sensors are available in two different form factors, namely Omni ONS and Mini ONS.

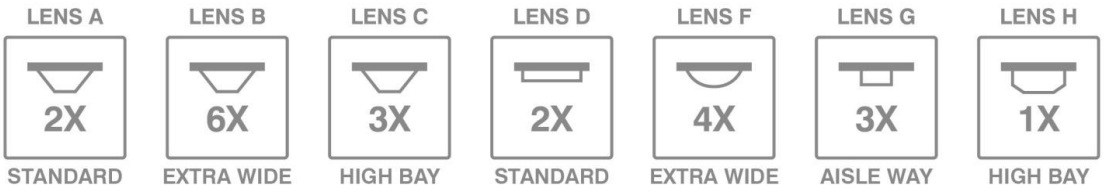
Omni ONS

The Omni ONS can be flexibly integrated with OEM luminaires or mounted on a ceiling in a variety of options. Changeable lens options allow the sensor to be mounted from typical office ceiling to high bay applications with different coverage. Detailed information about mounting and lens options are available from www.irtec.com.

Flexible Mounting Options



Changeable Lens Options



Mini ONS

The Mini ONS is a low profile OS-NET Sensor with a small flat lens specially designed for through-hole assembly with general office luminaire, such as Troffer or side-lit LED panel light.

- OS-NET Button (ONB)

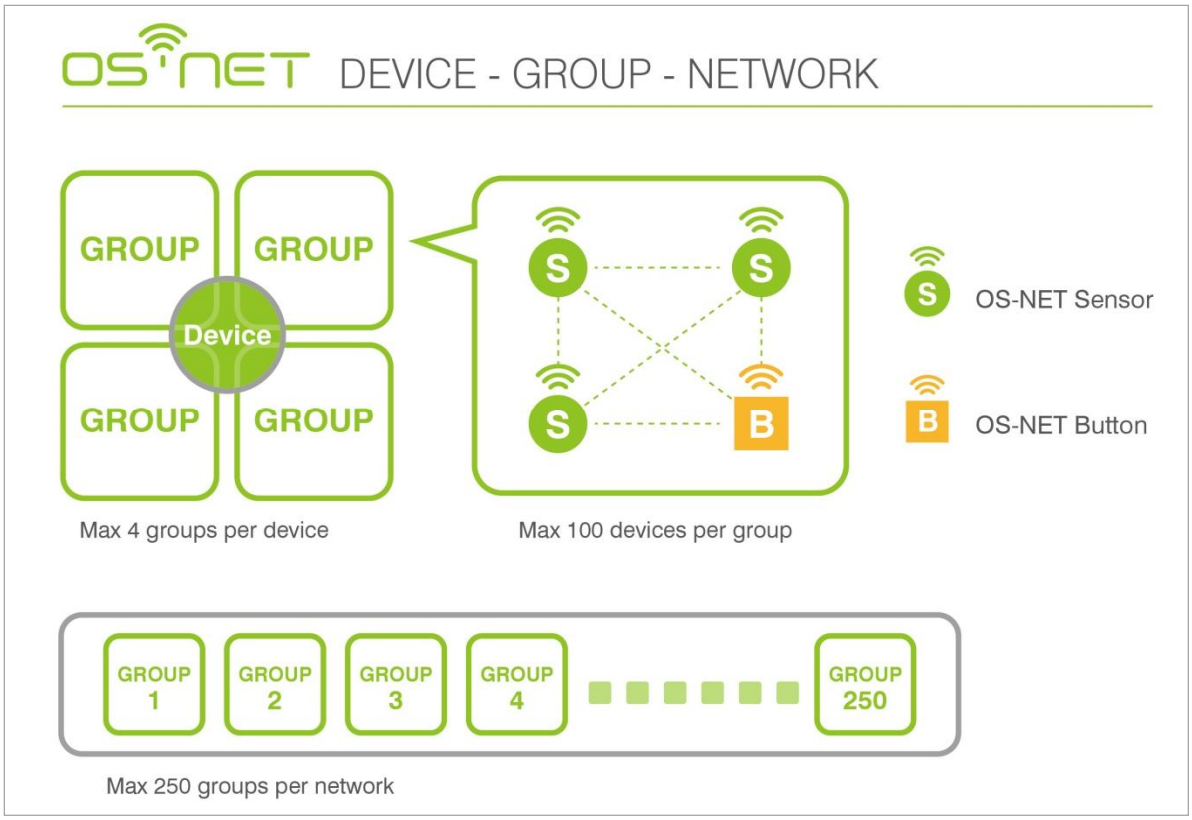
The OS-NET Button is an optional OS-NET device designed to replace the existing wall switch, as a line voltage powered wireless control device to provide manual on/off and dimming control to the lighting group assigned. The main function of the ONB is to allow the user to control the local lighting as required. OS-NET Buttons are available in two different form factors. The rectangular one is for mounting into standard NEMA wall box. The square one is for mounting into standard EURO wall box.

1.4 OS-NET Group

OS-NET group is basic structure of an OS-NET system to execute smart lighting control, also the pillar of creating an OS-NET wireless control network. An OS-NET control group can link up to 100 OS-NET devices which can be OS-NET Sensors or OS-NET Buttons. NOTE: Every OS-NET device must be grouped in order to link up the network.

1.5 OS-NET Network

OS-NET network refers to the wireless mesh network formed by a number of OS-NET devices through GROUP LINK process. An OS-NET network can link up to 250 groups. The coverage of an OS-NET network should be determined in accordance with the areas that require independent lighting control (ex. a company, a floor, a factory, or entire building). If the area is too large for a single OS-NET network to cover, a separate network can be established.



1.6 OS-NET Advantages

OS-NET is an extremely simple and smart lighting control solution packed with multiple sensing control technologies and top-notch wireless mesh networking capability. Through OS-NET platform, luminaires from different manufacturers can be applied in the same environment and harmoniously controlled by local OS-NET Sensors in various human-centric smart lighting control schemes via wireless mesh network. Numerous technological innovations delivered advantages that no other single wireless control solution can match.

Deploying the network through installing the OS-NET enabled luminaires and lighting circuits

Lighting designers typically require selecting or specifying certain types of luminaires for different applications according to the space characteristics and lighting requirements. The Omni ONS can be flexibly integrated with an OEM luminaire or mounted on the ceiling for circuit control via a specific mounting bracket, while Mini ONS can be integrated with low profile luminaires, such as Troffer or LED panel light.

Changeable lens options allow OS-NET to be applied in commercial and industrial lightings

Same as luminaire selection, the designer would have to select the adequate sensor according to the mounting height and space characteristic. Selecting appropriate sensors for all different applications can be challenging. To help designers eliminate the headache of sensor selection, multiple lens options are available for all Passive Infrared (PIR) based Omni OS-NET Sensors.

Only a handheld remote programmer needed to setup network, group devices and set control

Most lighting control systems, regardless of wired or wireless control, require a professional engineer to conduct system configuration and device settings. These tasks normally require extra equipment or exclusive management software to enable system operation. With OS-NET, an experienced installer can easily setup a network, group all devices, and set device control scheme via simple and intuitive operation on a handheld programmer.

A single device can be assigned to be member of multiple groups for multi-group activation

Through EZ-GROUP setting, each OS-NET device can be assigned to be member of up to 4 groups. This innovative feature easily enables multi-group activation control. With multi-group activation lighting control, many smart controls based on traffic flow, such as “pre-lighting before presence”, “directional guiding light”, and “multi-zone associated control” can be achieved via remote programmer setting.

No more complex devices and complicated settings required for achieving smart control

With the OS-NET solution, complex system/network devices are no longer required. Each OS-NET sensor has combined top-notch sensing and control technologies, including a digital occupancy sensor and daylight sensor, multi-scheme control algorithms, and state-of-the-art wireless mesh network communication. Whether they are integrated with luminaires or mounted on the ceiling, all can be easily setup to execute smart lighting control.

Available for different luminaires from different manufacturers ensuring open scalability

Broad applicability is just another outstanding advantage of OS-NET solution. Different luminaires from different manufacturers can be selected, installed in the same environment, and harmoniously controlled by wirelessly linked OS-NET Sensors and Buttons. Shorten lifecycle due to fast merging technology is typical for today’s LED lighting products. Once selecting OS-NET as the control solution, scalability will not be a concern.

2. Design Guideline

Designing, installing and setup an OS-NET smart lighting control system is much easier than most people would think.

To the lighting designer or specifier, just select the available OS-NET enabled luminaires according to the photometric characteristics, allocate the luminaires as you normally do, and layout mains power circuit as per Section 2.2 Power Supply described. If OS-NET enabled luminaires are not available or desirable, you can still allocate the selected luminaires and Omni ONS at proper positions to control the luminaires in the same way as typical occupancy sensors.

To the lighting installer, just install the OS-NET enabled luminaires according to the drawing and mounting instructions. Or mount the OS-NET Sensors at positions and connect local wires with luminaires and light circuit as per installation instructions. To control dimmable lighting by OS-NET sensor, the dim control signal from sensor should be “fed” to all drivers “in parallel”.

To the system commissioner, just follow the instructions of OS-NET Programming Guide (available from www.irtec.com), conduct group assignment to all OS-NET devices and sensor control settings via an OS-NET Remote Programmer. With OS-NET, you don’t need to operate any proprietary management software to register complex system devices through complicated commissioning process to establish wireless mesh network and get smart lighting control up and running.

2.1 Basic Understandings

- OS-NET is a platform that allows different types of luminaires from different manufacturers to achieve associated control through a wireless network.
- Every OS-NET enabled luminaire or lighting circuit is an independently operable smart lighting, whether it is linked with a wireless network or not.
- Allocating OS-NET enabled luminaires and OS-NET devices is almost same as allocating conventional luminaires, occupancy sensors, and wall switches.
- To enable group control, every OS-NET device MUST be grouped to link up with the network, regardless of luminaire integrated or independently mounted.
- Each OS-NET device can be assigned to be members of up to 4 groups. The maximum number of device per group should not exceed 100.
- To execute dimming control, you need to select luminaire equipped with correct type (0-10V or DALI) of dimmable driver/ballast. NOTE: Not all luminaires are dimmable.
- ONE dimmable driver/ballast can only receive ONE dimming control signal, no matter how many sets of light sources are connected.

2.2 Power Supply

To ensure reliable network communication, all nodes should be constantly powered. Manual power interruption of local lighting circuit (e.g. switching off the power to a lighting circuit) not only will disable local lighting control, but also could likely disconnect the network and thus disable the associated group control. Therefore, all OS-NET enabled lightings should be constantly powered. Other than this, power supply circuit design for OS-NET smart lighting control is same as conventional lighting. You may follow below principles to design power supply circuits for OS-NET in a new building or an existing building.

For a new building, suggest eliminating the wall switch for local control to avoid power being accidentally switched off and disconnecting the mesh network. Equip with proper circuit breakers to provide power safety protection and allow disconnecting the circuit power for service. If manual on/off or dimming control is required for places like conference rooms, classrooms, brief rooms, meeting rooms, or private offices, a typical wall box can be allocated at proper position with mains power supply for OS-NET Button.

For an existing building, suggest removing or bypassing the original wall switch to avoid power being accidentally switched off and disconnecting the mesh network. If manual on/off or dimming control is required for places like conference rooms, classrooms, brief rooms, meeting rooms, or private offices, you may replace the original wall switch with an OS-NET Button. NOTE: The OS-NET Button requires LINE and NEUTRAL connection to operate.

2.3 Integrating OS-NET Sensor with luminaire

The OS-NET Sensor can be directly integrated with a luminaire or via specific mounting bracket. For more information about luminaire integration, please refer to the Mounting Option Datasheet available on www.irtec.com and also take the followings into consideration prior to integration;

- To directly integrate an OS-NET Sensor with a luminaire, ensure that the luminaire has sufficient internal space for sensor assembly.
- If possible, assemble the OS-NET Sensor away from heat sources such as driver or LED module.
- To avoid interfering sensor operation, ensure no strong light source in front of the OS-NET Sensor.

2.4 Allocating the OS-NET Sensors

An OS-NET system is mainly formed by numerous of OS-NET Sensors that are either luminaire integrated or mounted on the ceiling. To allocate the OS-NET Sensors for lighting circuit control, please refer to the following instructions;

- Avoid placing the sensors at inadequate positions

Avoid placing the sensor at position nearby a HVAC vent, with direct sunlight, or on unstable surface. Also do not allocate the sensor above the cable tray, duct, or other hanging objects that may block the sensor detection. Relocate the sensor at other position to avoid above objects or adding additional sensor and assign it to the same group.

- Ensure the sensor can “see” the presence and motion

In general, passive infrared (PIR) based occupancy sensors are more sensitive to the motions moving “across” its detection zones than “toward” the sensors. Many design innovations and broadcasting group control concept allow you to just allocate the OS-NET Sensor at a position where it can “see” the presence and motion of occupant, and then the OS-NET solution will do the job.

- Select adequate lens according to the mounting height

Every passive infrared (PIR) based occupancy sensor requires an optical part (ex. a Fresnel lens) to provide motion sensing capability. Multiple lens options featuring different form factors are available for the Omni ONS to provide distinctive coverage for applications with various mounting heights. You may refer to the Lens Datasheet available from www.irtec.com to select adequate lens according to the detection requirement and mounting height.

3. Group Control

Group control is the basic structure of OS-NET smart lighting solution. An independent OS-NET network can link up to 250 groups, and each group can consist of 1 to 100 OS-NET devices. Each OS-NET Sensor of the group will activate the programmed control to the connected lighting once receiving the OCC (occupied) signal from any OS-NET sensor of the group. All OS-NET Sensors of a group can be programmed by GROUP-SET operation to execute the desired sensing control scheme with identical parameters. If different control is required, the specific OS-NET sensor can be individually programmed by INDIV-SET operation to execute a different control scheme with its own parameters.

"Individual sensing control, group activation" is the core concept of OS-NET smart lighting control, which is also the essence that makes the OS-NET a simpler and smarter solution. The OS-NET group control is actually a combined operation of TRANSMITTING and RECEIVING groups. It means whenever an OS-NET Sensor detects the presence or movement of occupant, the detecting sensor not only controls the connected lights as set, but also broadcasts the occupied (OCC) signal based on the TRANSMITTING group number assigned to the OS-NET Sensors with the same RECEIVING group number to execute the programmed control respectively.

3.1 EZ-GROUP

Grouping is the fundamental setup work to establish an OS-NET smart lighting control system. Every OS-NET device, regardless of its functionality, requires group assignment to link up the network and becoming a node of mesh network.

EZ-GROUP is a quick setting process which will set all grouped devices with the same number of TRANSMITTING and RECEIVING groups. Using the EZ-GROUP setting will not only allow you to easily establish a new OS-NET network, but also quickly complete grouping the OS-NET Sensors for most applications with typical controls.

3.2 ADVANCED

Although EZ-GROUP can be broadly used to group most OS-NET Sensors with respective sensing control schemes, some applications may require special controls, such as "pre-lighting before presence", "directional guiding light", or "multi-zone associated control", which would require the "ADVANCED" setting to achieve.

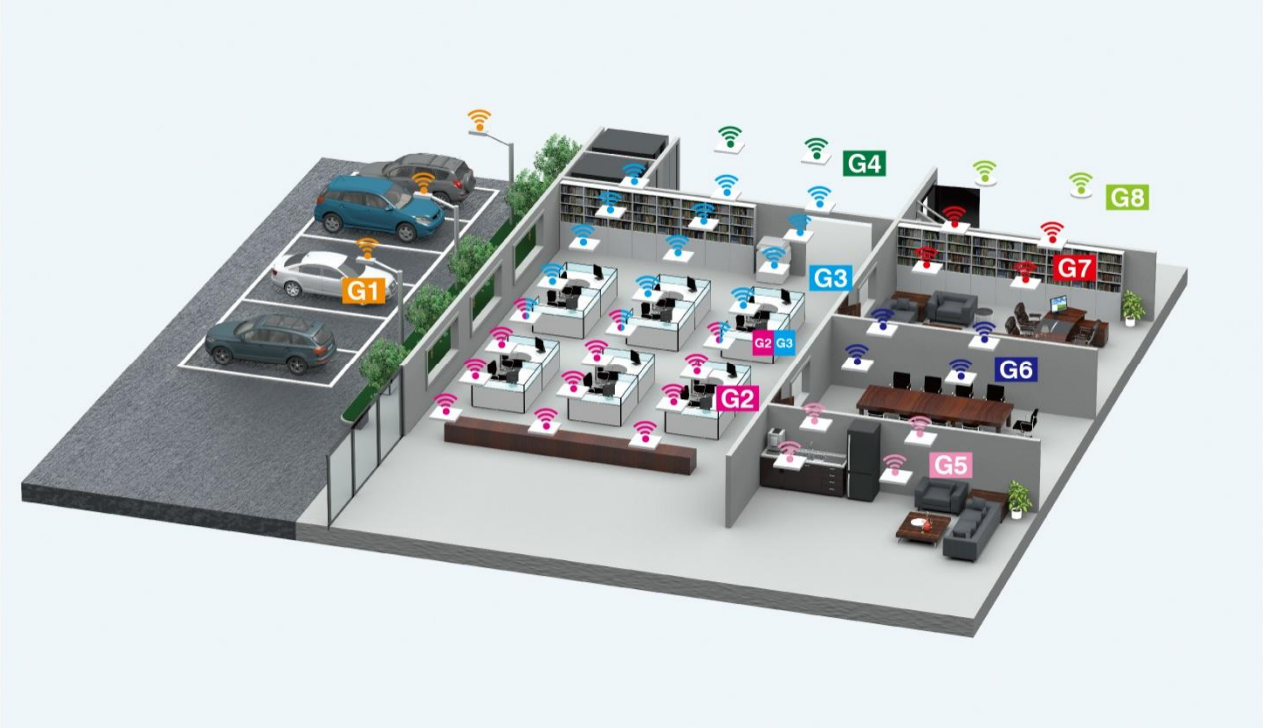
Example: When Zone A is occupied, the lighting at Zone A and B should be activated. But when Zone B is occupied, only the lighting at Zone B is required to be activated.

To achieve the above control, you can use EZ-GROUP to setup the OS-NET Sensors of Zone A and B with respective group numbers, then use the ADVANCED setting to change the number of TRANSMITTING or RECEIVING group of zone sensors. You can either add the group number of Zone B to the TRANSMITTING group of Zone A sensors, or add group number of Zone A to the RECEIVING group of Zone B sensors.

3.3 Grouping Tips

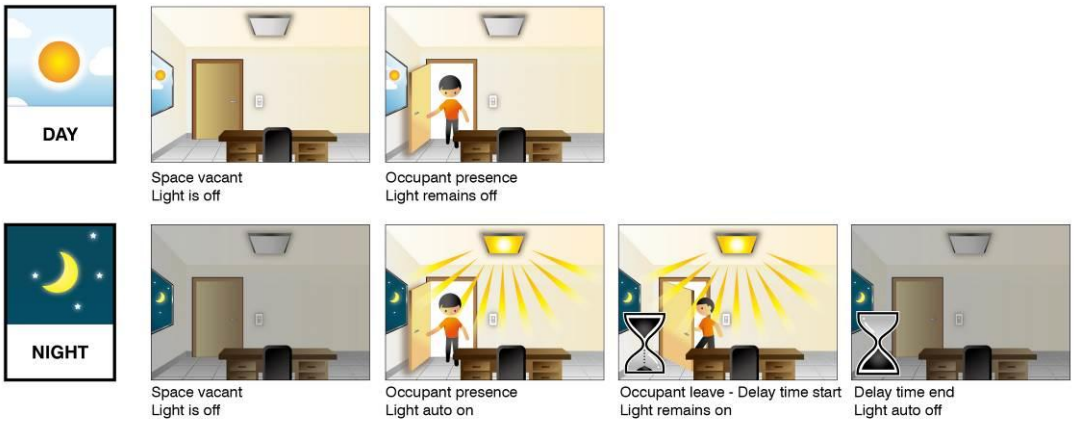
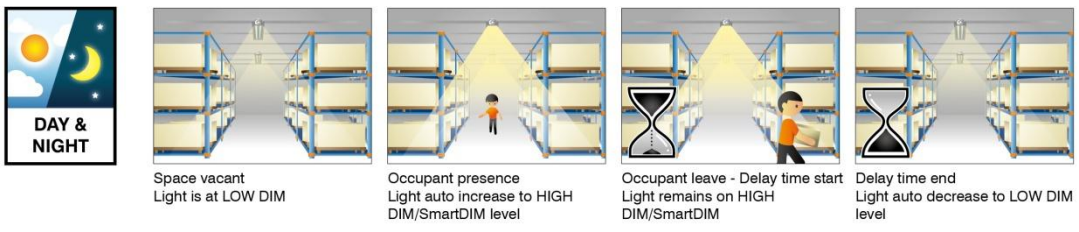
After allocating all the OS-NET enabled luminaires and OS-NET Sensors, the designer may assign the control groups for all OS-NET devices, according to the space functions, control requirements, and traffic flows of occupants. The following tips are prepared for the reference of group assignment.

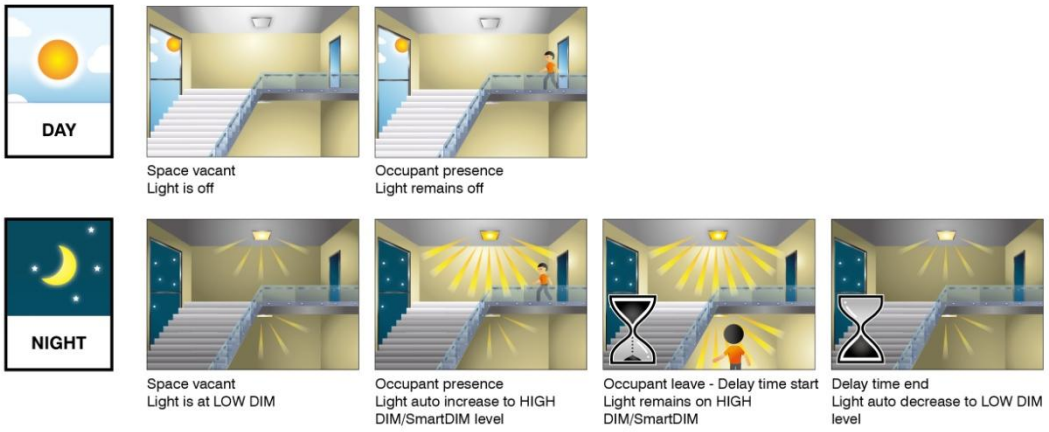
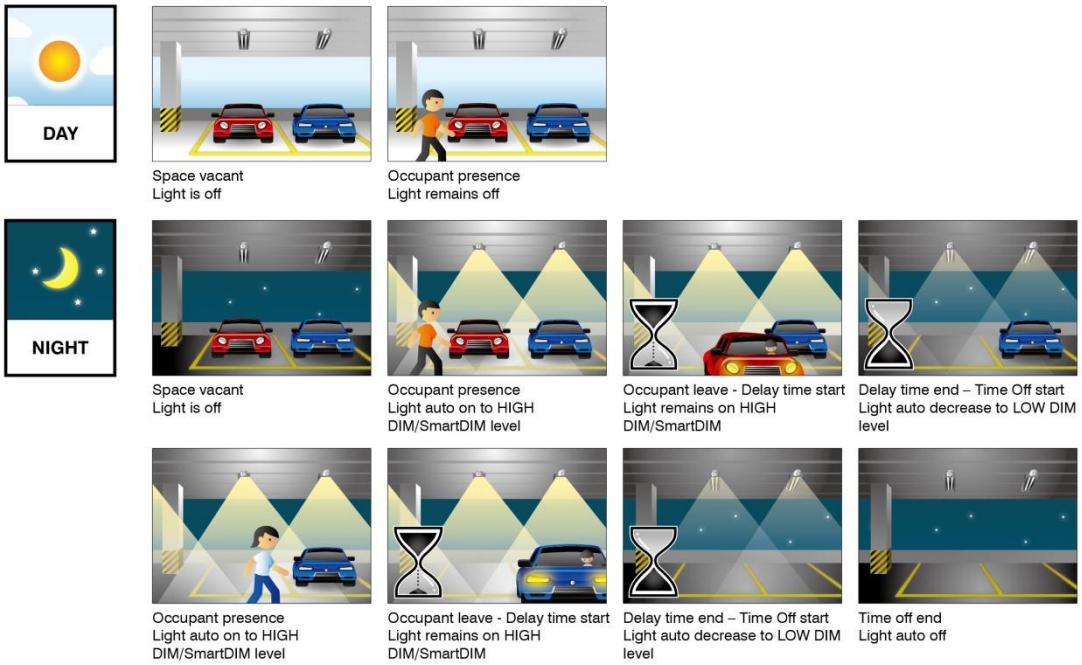
1. If specific sensing control scheme is required, certain sensors can be assigned to different groups or separately set to execute different controls. All OS-NET Sensors at the same zone are not necessarily to be assigned to the same group.
2. If all luminaires in the same zone are required to be activated all together as a group, just assign all sensors to the same group.
3. If manual on/off/dim control is required, then an OS-NET Button shall be installed and assigned to the controlled lighting group.
4. If different sensing controls are required by the luminaires of the same zone, you may assign all sensors to the same group, and then set individual OS-NET Sensor with desired sensing control scheme and parameters. You may also assign the OS-NET Sensors that are required to execute different controls with distinctive group numbers.
5. For places with multi-directional traffic flows, such as crossway of parking garages, grand lobbies and elevator halls, the sensors above these positions can be assigned to be members of lighting groups of all possible forward paths. Thus the lights of all associated groups will be activated simultaneously whenever the sensors of these places detect the presence of occupant.

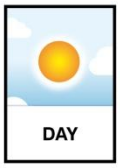


4. Sensing Control Schemes

Each OS-NET Sensor can be set to provide a specific control scheme derived from different sensing control strategies. These strategies utilize Occupancy Sensing, Vacancy Sensing, or Daylight Sensing technology, and associate with typical On-Off Switching, bi-level StepDIM or continuous SmartDIM to control the connected lights.

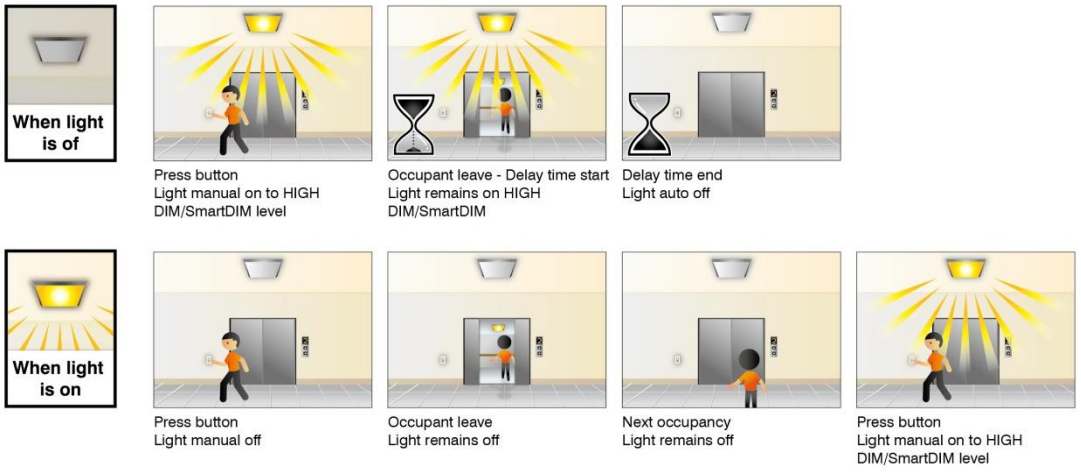
SCHEME	DESCRIPTION
ON/OFF	This is a typical occupancy sensing control scheme. Lighting will be inhibited when the ambient light level is higher than the set threshold, regardless of occupancy or vacancy. When the ambient light level is lower than the set threshold, the controlled light will be automatically turned on once the sensor detects the presence of occupant, and turned off after the delay time elapsed. NOTE: This scheme can be used with dimmable or non-dimmable lighting, but not for HID lighting. 
OSO	This is an occupancy sensing control scheme can be applied in areas that require 24-hour lighting. When space is vacant, the lights will be maintained at Low Dim level. Whenever space is occupied, lighting output will be increased to High Dim level or continuously regulated to maintain within the pre-set range by SmartDIM control. NOTE: Do NOT use this scheme to control non-dimmable lighting. 

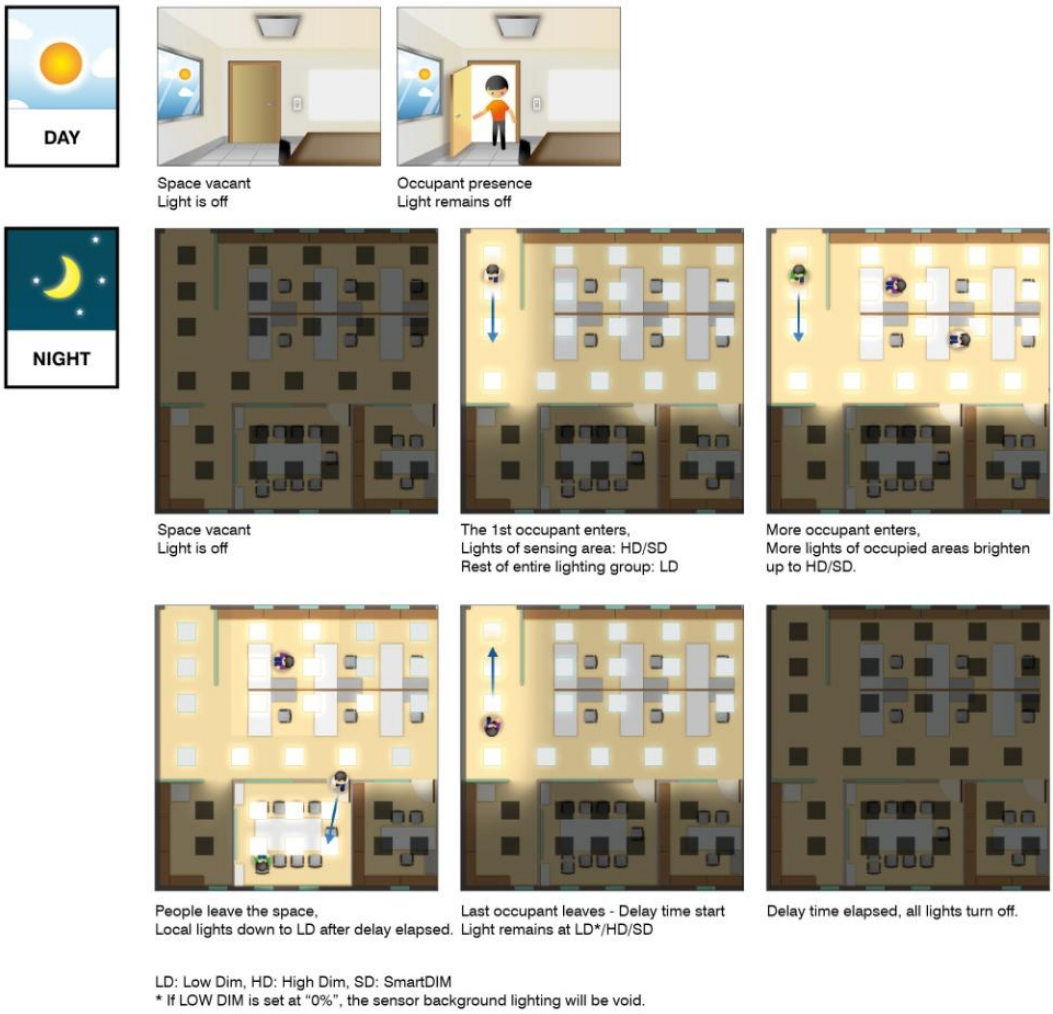
SCHEME	DESCRIPTION
OSLA	This is an occupancy sensing control scheme can be applied in spaces that require automatic lighting when the ambient light level is lower than the set threshold. Lighting will be inhibited if the ambient light level is higher than the set threshold, regardless of occupancy or vacancy. When the ambient light level is lower than the set threshold, the sensor will automatically control the light at Low Dim level. When sensor detects the presence of an occupant, lighting output will be increased to the High Dim level or continuously regulated within the pre-set range by SmartDIM control. After the delay time elapsed, lighting output will be reduced to Low Dim level or shut off if the ambient light is higher than the set threshold. NOTE: Do NOT use this scheme to control non-dimmable lighting. 
OSLATO	This is an occupancy sensing control scheme can be applied in spaces that require maintaining Low Dim lighting for a period of time before shutting off. Lighting will be inhibited if the ambient light level is higher than the set threshold, regardless of occupancy or vacancy. When the ambient light level is lower than the set threshold, and any sensor detects the presence of occupant, lighting output will be increased to High Dim level or continuously regulated to maintain overall lighting level within the pre-set range by SmartDIM control. After the delay time elapsed, lighting output will be reduced to Low Dim level for a period of TIME OFF delay before shut off. NOTE: This scheme requires dimmable lighting to enable dimming control. If lighting is non-dimmable, there will be no dim control and the delay time will be extended with the TIME OFF (TO) delay. 

SCHEME	DESCRIPTION
DSVM	This is a daylight sensing control scheme can be applied in spaces that require automatically dimming the lighting output to a low level between a certain time before and after virtual midnight. Lighting will be inhibited if the ambient light level is higher than the set threshold. When the ambient light level is lower than the set threshold, the sensor will turn the light to High Dim level or continuously regulate the output to maintain overall lighting level within the pre-set range by SmartDIM control. Lighting output will be reduced to Low Dim level from a certain time before virtual midnight to a certain time after. NOTE: This scheme requires dimmable lighting to enable dimming control. If lighting is non-dimmable, all lights will remain on whenever ambient light level is lower than the set threshold.   Daytime Light is off   Nighttime Light auto on to HIGH DIM/SmartDIM level  From a set time before midnight (VM-TB) to a set time after midnight (VM-TA) Light auto decrease to LOW DIM level  From VM-TA to daytime Light auto increase to HIGH DIM/SmartDIM level
DSC	This is a daylight sensing control scheme can be applied in spaces that require automatic lighting whenever the ambient light is lower than the set threshold. The sensor will automatically turn on the light to High Dim level or continuously regulate the output to maintain overall lighting level within the pre-set range by SmartDIM control when the ambient light level is lower than the set threshold, and automatically turn off the light when the ambient light level is higher than the set threshold. NOTE: This scheme requires dimmable lighting to enable dimming control. If lighting is non-dimmable, all lights will remain on whenever ambient light level is lower than the threshold.   Daytime Light is off   Nighttime Light auto on to HIGH DIM/SmartDIM level

SCHEME	DESCRIPTION
VSC	This is a vacancy sensing control scheme can be applied in spaces that require users to manually turn on the light, and have the sensor turn off the light automatically. The occupant would have to press the OS-NET Button to turn on the lighting group assigned. The sensor will control the lights at High Dim level or continuously regulate the output to maintain overall lighting level within the pre-set range by SmartDIM control. The sensor will control the connected lighting as per OSLATO scheme. NOTE: This scheme requires dimmable lighting to enable dimming control. If lighting is non-dimmable, there will be no dim control and the delay time will be extended with the TIME OFF (TO) delay.

Push-Button Operation



SCHEME	DESCRIPTION
OSB	This is an advanced occupancy sensing control scheme can be applied in open offices to provide background light level before the area of entire lighting group is vacant. Lighting will be inhibited if the ambient light level is higher than the set threshold, regardless of occupancy or vacancy. When the ambient light level is lower than the set threshold and the first occupant is detected by a grouped sensor, the output of sensor connected light will be increased to High Dim level or continuously regulated within the pre-set range by SmartDIM control during occupancy, and the unoccupied areas of entire lighting group will brighten up to Low Dim level as background light. The entire lighting group turns off after the last person leaves and delay time elapsed. NOTE: Do NOT use this scheme to control non-dimmable lighting.  LD: Low Dim, HD: High Dim, SD: SmartDIM * If LOW DIM is set at "0%", the sensor background lighting will be void.
OFF	This is a manual control scheme can be used when you need the light to be off for a certain period of time. Once this scheme is set, all OS-NET controlled lighting will remain off until another scheme is selected.

5. Applications and Control Scheme Recommendations

The following table highlights typical OS-NET applications and control scheme recommendations for reference. For other unlisted applications, you may refer to the application with similar function and occupancy activity, or contact info@irtec.com for availability and assistance.

APPLICATIONS	ON/OFF	OSO	OSLA	OSLATO	DSVM	DSC	VSC*	OSB
Classroom	○			●			●	
Conference room	○			●			○	
Corridor/Hallway	○	●[1]	●[2]					
Entrance hall/Lobby	○	●[1]	●[2]					
Gymnasium	○			●				
Kitchen/Break room	○			●			○	
Lecture hall	○			●			○	●
Office-open	○			●				●
Office-private	○			●			●	
Operation area	○	○[1]	○[2]	●				
Outdoor-perimeter	○		●		○	○		
Park/play ground	○		●		○	○		
Parking lot	○		●	○	○			
Parking garage-driveway		●[1]	●[2]	○				
Parking garage-space	●			○				
Restroom/locker room	○	○[1]	○[2]	●				
Stairwell	●	○[1]	○[2]				○	
Storage	●			○			○	
Utility room	●			○			○	
Warehouse	○			●				

● - Recommended ○ - OK to use

* ONB is required to enable Vacancy Sensing Control (VSC).

[1] Area without daylight but requires 24-hour lighting for safety or other purposes.

[2] Area with daylight but requires 24-hour lighting for safety or other purposes.