nLight® AIR Design Guide

Please read this document prior to designing nLight AIR systems for either retrofit or new construction.

Designs that do not adhere to these guidelines may have performance problems once installed and configured. Following the information in this guide will significantly increase the likelihood of a trouble-free startup.

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1-1 nLight AIR Design Limitations

STAND-ALONE SYSTEMS

When designing a stand-alone nLight AIR system, one must design to the following practices:

- No more than 128 devices per Group
- Design stand-alone spaces as Groups. A Group is a collection of devices that occupy the same room or space and share the same behaviors.
- Assumed range should not exceed more than three hops at budgetary range through the interior of a building (inclusive of an initial broadcast from a Group Monitor and two repeats using devices in the space)
- Assumed range should not exceed more than four hops from a Group Monitor using line of sight communication (inclusive of an initial broadcast from a Group Monitor and three repeats using devices in the space)

NETWORKED SYSTEMS

When designing a networked nLight AIR system, one must design to the following practices:

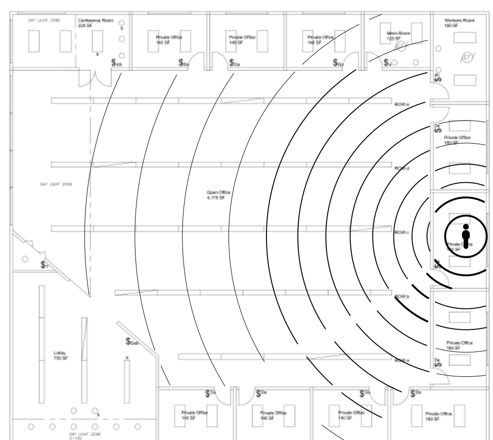
- No more than 255 nLight ECLYPSE devices per Site
- No more than 750 devices per nLight ECLYPSE
- No more than 20,000 devices per Site
- No more than 128 devices per Group
- One Site per instance of SensorView
- For maximum distance between networked devices, see Section 2
- Assumed range should not exceed more than three hops at budgetary range through the interior of a building (inclusive of an initial broadcast and two repeats using devices in the space)
- Assumed range should not exceed more than four hops between devices using line-of-sight communication (inclusive of an initial broadcast and three repeats using devices in the space)

1-2 Wireless Communication Principles

nLight AIR equipment communicates in the 900MHz band (904 - 926 MHz). This frequency band allows for longer communication distances in both open air and through obstructions.

However, each additional obstruction reduces the signal strength and overall communication distance.

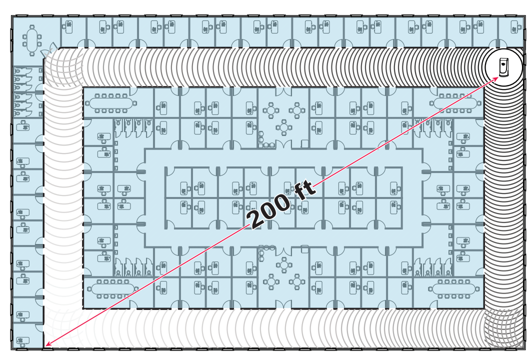
Consider the example to the right. If trying to communicate with all others in space by yelling, a voice will better propagate through the space in some ways better than others. If standing in a private office on the right-hand side, a voice may only travel though a few walls before it is no longer strong enough to be heard. However, it may be able to travel out into the open office space and be heard in areas across the floor – keeping in mind that sound can reflect and enter spaces not in direct line-of-sight. These same principles are true with radio frequency (hereafter referred to as "RF".) All materials have some finite impact on the signal strength of RF, much like they do a voice.



Designs should include line-of-sight communication as a goal, followed by reflected signal, and lastly by penetration through obstacles. This approach ensures the most reliable communication between devices.

Each additional obstruction will reduce the signal strength.

The graphic to the right shows how distance and reflection change the signal strength in an environment. Compared to the signal strength of reflections, nLight AIR's RF signal strength over 200' line-of-sight would be much stronger than attempting to penetrate multiple walls.



nLight AIR Design Guide

Through nLight AIR autonomous bridging technology, wireless devices that are neither switch-type nor battery-powered can be used as repeaters, enabling the ability to repeat messages to and from an nLight ECLYPSE™ or Group Monitor without adding additional devices to the space.

Network messages that can be repeated include profiles, settings updates made through SensorView, BACnet commands and polling, firmware updates, and other network communication.

Non-networked (standalone) messages that can be repeated across groups of AIR devices include switch, occupancy sensor, and photocell broadcasts. Broadcasts from battery powered devices and switch devices must reach the group monitor before they can be repeated. Non-battery/non-switch broadcasts can be repeated to reach a Group Monitor and can be repeated from the Group Monitor to the receiving device(s).

Devices that can act as repeaters through autonomous bridging include the rPP, rES7, rIO, rCMS, rSDGR, rMSOD, rLSXR, rSBOR, and rSBG.

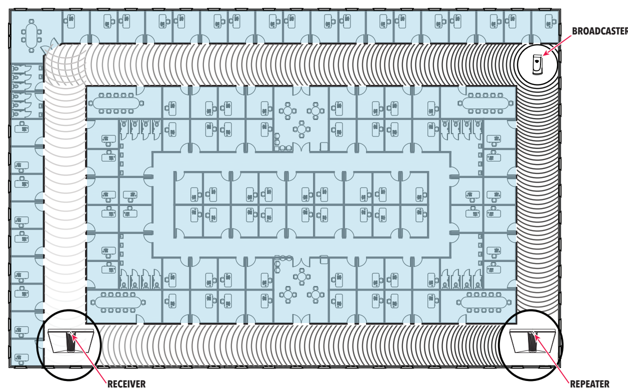
Battery powered devices and switches cannot serve as repeater candidates. Such devices include the rPODB, rPODL, and rCMSB.

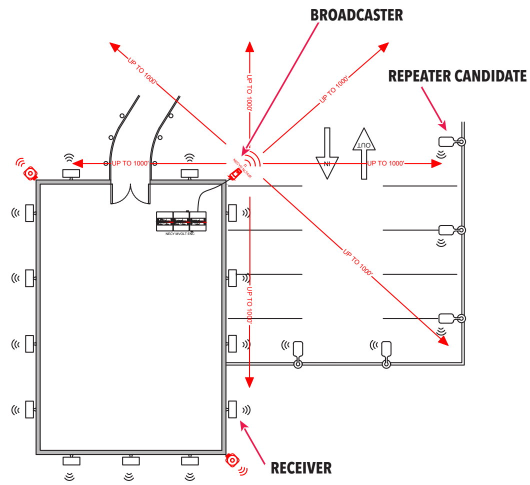
When verifying repeater candidate viability, the following should be considered at a minimum:

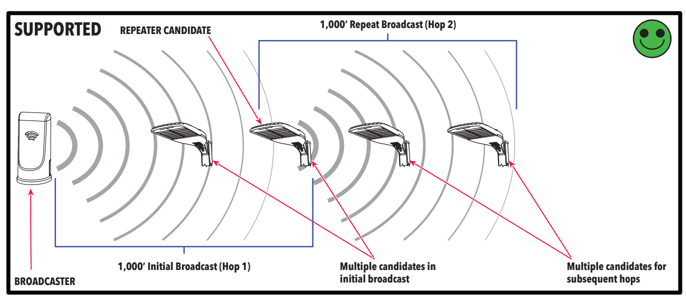
- Distance between a broadcaster and repeater candidates should be less than the budgetary range recommended for a space type.
- Distance between repeater candidates and a receiver should be less than the budgetary range recommended for a space type.
- Designers should confirm that no significant obstructions exist between respective broadcaster, repeater candidates, and receiver devices.

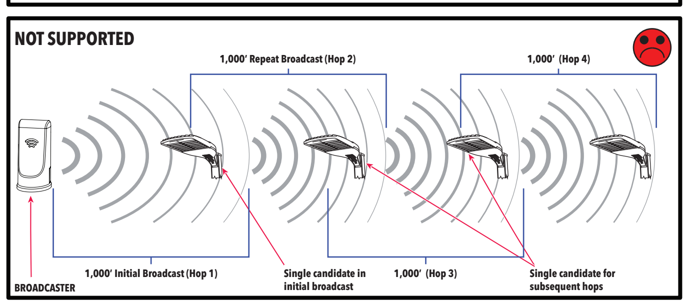
Designs should not rely on autonomous bridging when multiple repeater candidates are not available.

Autonomous bridging adds reliability to an nLight AIR design by making use of devices in the space. As the quantity of devices over a given distance lowers, the opportunity for a reliable network self-forming or self-repairing is reduced.







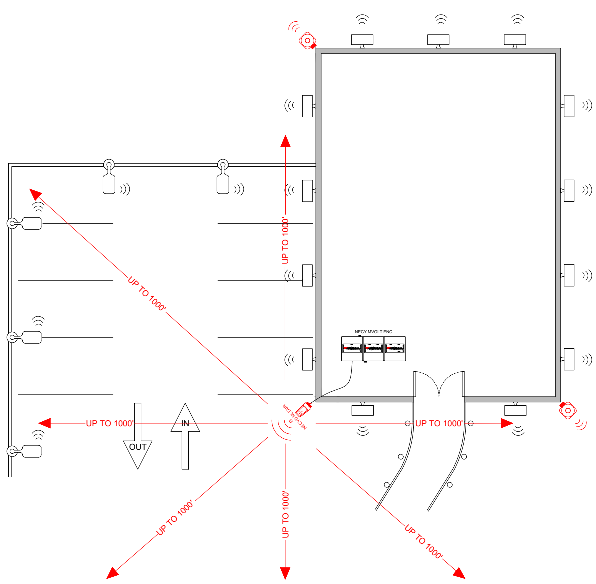


2-1 Range Considerations: Outdoor Applications

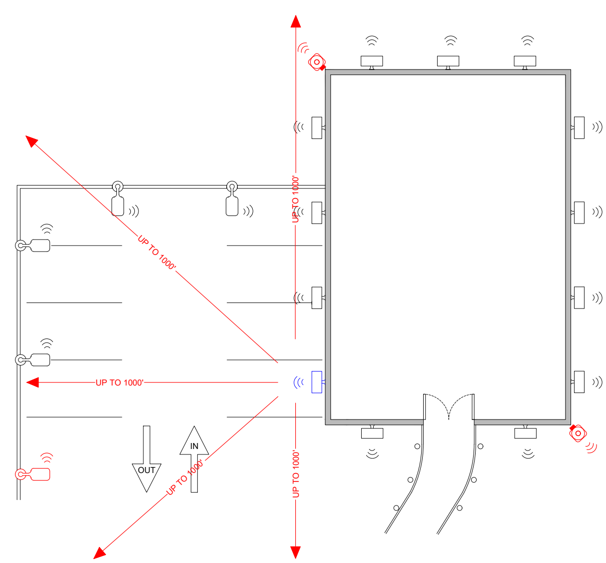
Typical Parking Lot or Building Exterior

Use 1,000' radius (line-of-sight communication only) for budgetary purposes when all obstructions cannot be confirmed and avoided or when signal strength has not been tested.

- Maximum budgetary range should consist of no more than an initial broadcast and three repeats using devices in the space.
- For networked systems, an nLight AIR Adapter (NECYD NLTAIR G2, hereafter referred to as "Adapter") should be mounted outside on a wall or edge of a roof. Mounting on the corner of walls allows for the widest field of view and maximum coverage outdoors – 270 degrees field of view.
  - For site applications, it is desirable to get the clearest path and best unobstructed view from the Adapter to the fixtures being controlled.
  - Radio frequency (RF) strength will weaken when penetrating exterior walls due to their typical construction. Mounting an Adapter on an exterior wall--not a corner--will limit its range to 180 degrees of view.
  - Tall fences or thick foliage can reduce signal strength.
  - A higher mounting height is typically better for avoiding obstructions and increasing range. Lightning protection systems per UL96 may be necessary depending on the Adapter mounting height.
  - For protection from the elements, it is best to mount the Adapter under an overhang or canopy while still retaining a clear field of view from underneath the structure.
  - When mounted outdoors, the Adapter must be mounted on an IP66 rated, plastic enclosure with the gasket compressing against the surface.
  - In areas where regular snow accumulations are expected, it is recommended to mount the Adapter on the bottom of a box to avoid snow buildup around the Adapter.
- When designing with autonomous bridging and multiple repeater candidates do not appear at a given hop layer, additional devices should be added to act as alternative repeater candidates – a requirement for a robust and reliable repeater network. An rSBOR or rPP20 CP (with exterior box by others, as needed per the application environment) are versatile candidates that can be positioned to act as repeaters.



Networked ABT* - Typical Parking Lot



Standalone ABT* - Typical Parking Lot

*****Red nLight AIR devices and fixtures are representative of repeater-enabled devices.

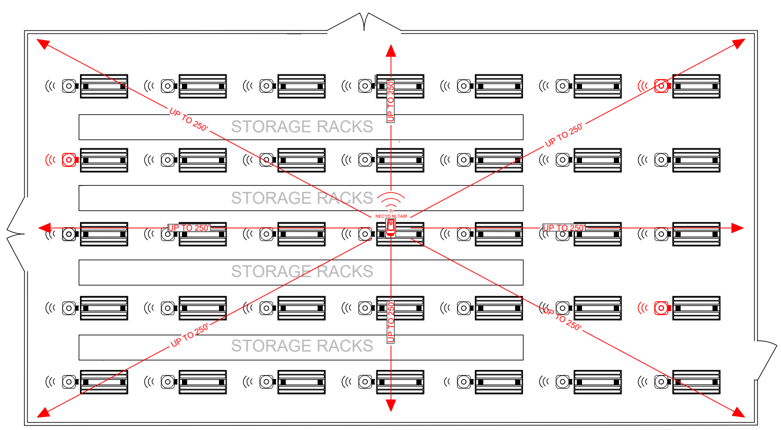
*****Blue devices and fixtures are representative of Group Monitors

2-2 Range Considerations: Indoor Applications

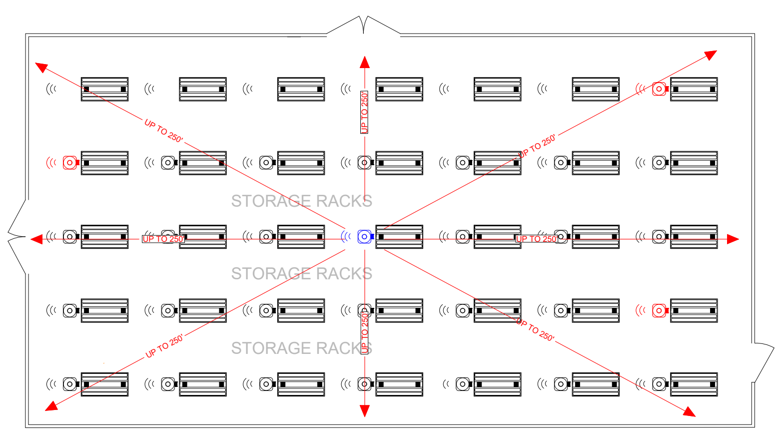
Typical Industrial / Warehouse Applications

Use 250' radius for budgetary purposes when all obstructions cannot be confirmed and avoided, when machinery and rack realignment is expected, or when signal strength has not been tested.

- Maximum budgetary range is 750' radius (inclusive of repeats), unless a proper site survey has been performed to verify better performance.
- Typical construction is defined as large areas of open space with minimum obstructions between the Adapter (or Group Monitor) and nLight AIR receiver.
- If networked, the Adapter should be mounted at the same height as other devices in the space (such as wireless sensors) to aid in avoiding obstructions.
- For networked applications, a minimum of one Adapter should be used per floor.
- When designing with autonomous bridging and multiple repeater candidates do not appear at a given hop layer, additional devices should be added to act as alternative repeater candidates – a requirement for a robust and reliable repeater network. An rSBOR, rPP20, or rCMS (connected to an added or existing rPP20) is a versatile candidate that can be positioned to act as an alternative repeater.



Networked ABT* - Typical Warehouse



Standalone ABT* - Typical Warehouse

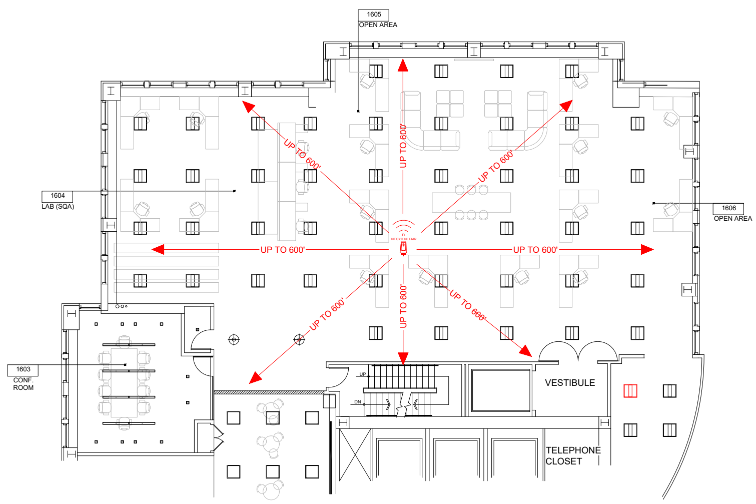
*****Red nLight AIR devices and fixtures are representative of repeater-enabled devices.

*****Blue devices and fixtures are representative of Group Monitors

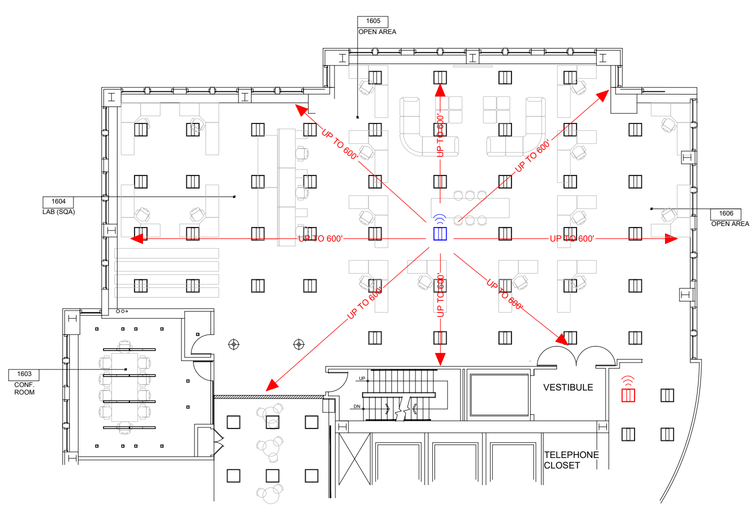
Typical Commercial Office Space

Use 150' radius for budgetary purposes when all obstructions cannot be confirmed and avoided or signal strength has not been tested.

- Maximum budgetary range is 450' radius (inclusive of repeats), unless a proper site survey has been performed to verify better typical performance.
- Penetration of consecutive private office walls will diminish signal strength. Minimum, budgetary signal strength should be considered when penetrating more than three dry walls of average construction.
- Open office and long hallways will improve range and are best choices for Adapter placements in networked applications.
- For networked applications, a minimum of one Adapter should be used per floor.
- When designing with autonomous bridging and multiple repeater candidates do not appear at a given hop layer, additional devices should be added to act as alternative repeater candidates – a requirement for a robust and reliable repeater network. An rPP20 or rCMS (connected to an added or existing rPP20) is a versatile candidate that can be positioned to act as an alternative repeater.



Networked ABT* - Typical Office



Standalone ABT* - Typical Office

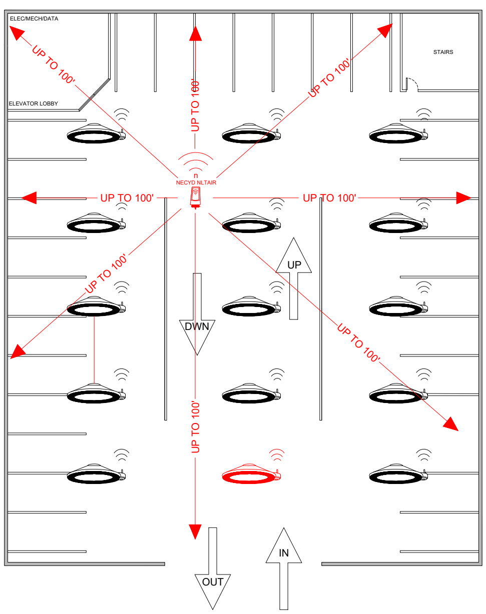
*Red nLight AIR devices and fixtures are representative of repeater-enabled devices.

*Blue devices and fixtures are representative of Group Monitors

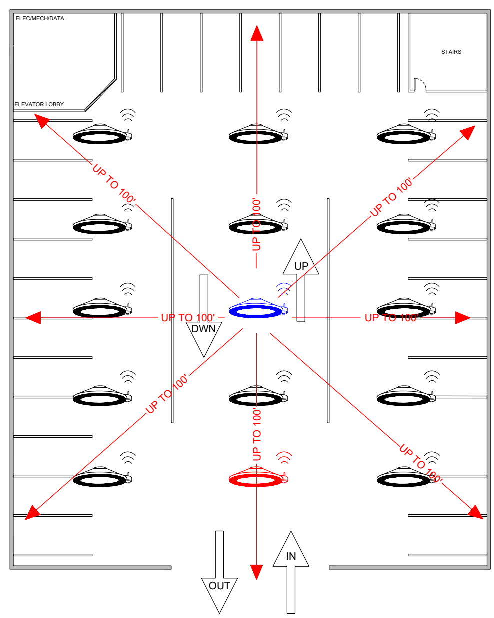
Typical Commercial Parking Garage

Use 100' radius for budgetary purposes when all obstructions cannot be confirmed and avoided or signal strength has not been tested.

- Maximum budgetary range is 300' radius (inclusive of repeats), unless a proper site survey has been performed to verify better typical performance.
- Reflections from floor to ceiling will be the primary means of communication in parking garages with vertical webs. The budgetary distance (100') should be used if construction type is unknown.
- For networked applications, a minimum of one Adapter should be used per floor, unless a proper site survey has been performed and confirms that strong signal strength is available between the Adapter and multiple repeater candidates on another floor.
- When designing with autonomous bridging and multiple repeater candidates do not appear at a given hop layer, additional devices should be added to act as alternative repeater candidates – a requirement for a robust and reliable repeater network. An rSBOR, rPP20 CP, or rCMS (connected to an added or existing rPP20) is a versatile candidate that can be positioned to act as an alternative repeater.



Networked ABT* - Typical Parking Garage



Standalone ABT* - Typical Parking Garage

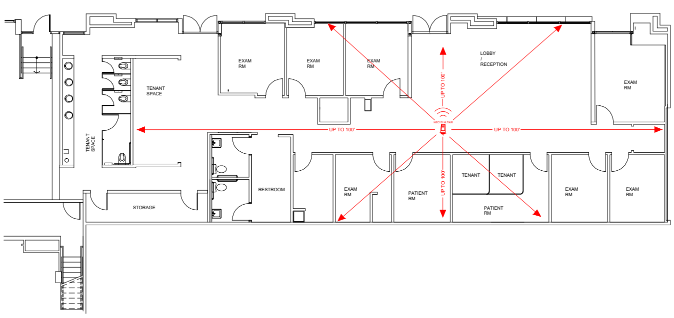
*****Red nLight AIR devices and fixtures are representative of repeater-enabled devices.

*****Blue devices and fixtures are representative of Group Monitors

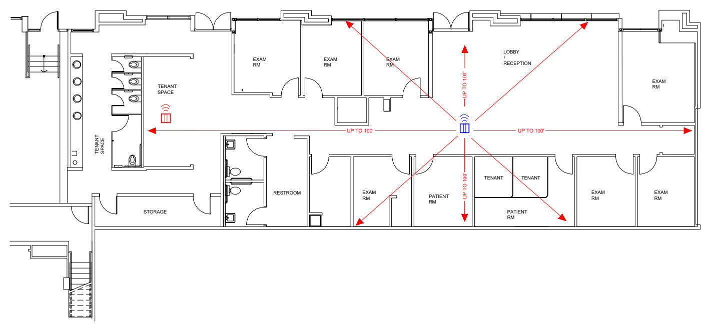
Typical Municipal Buildings, Schools, and Hospitals

Use 100′ radius for budgetary purposes when all obstructions cannot be confirmed and avoided or when signal strength has not been tested.

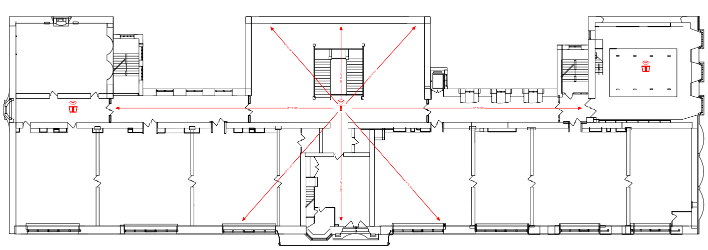
- Maximum budgetary range is 300′ radius (inclusive of repeats), unless a proper site survey has been performed to verify better performance.
- Cinderblock construction (sometimes with concrete pour inside the block and rebar reinforcement) brick walls, school lockers, and consecutive smaller room sizes diminish wireless range.
- For networked applications, a minimum of one Adapter should be used per floor.
- When designing with autonomous bridging and multiple repeater candidates do not appear at a given hop layer, additional devices should be added to act as alternative repeater candidates – a requirement for a robust and reliable repeater network. An rPP20 or rCMS (connected to an added or existing rPP20) is a versatile candidate that can be positioned to act as an alternative repeater.



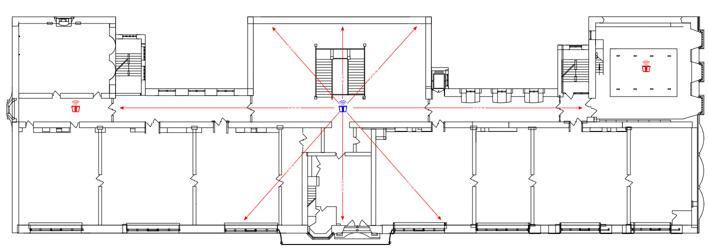
Networked ABT* - Typical Medical Center



Standalone ABT* - Typical Medical Center



Networked ABT* - Typical School



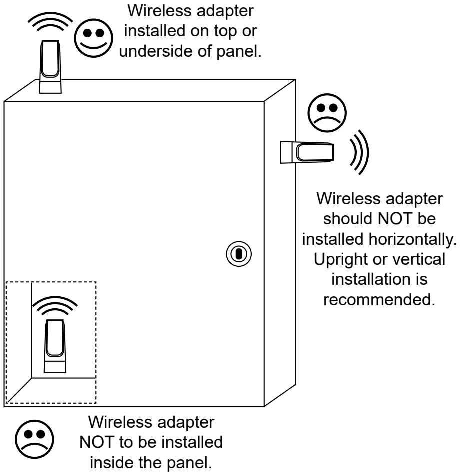
Standalone ABT* - Typical School

*Red nLight AIR devices and fixtures are representative of repeater-enabled devices.

*Blue devices and fixtures are representative of Group Monitors

3-1 Adapter Mounting Notes

- Mounting the Adapter in large, straight, and open spaces maximizes range. For maximum signal strength, avoid mounting with one or more blind bends between the Adapter and the end device or fixture. Autonomous bridging through devices in the space can be used to overcome blind bends; this is done by following the recommendations in Section 2.
- The Adapter should be mounted vertically in the center of the chosen space, clear of any obstructions (metal or concrete obstructions are especially important to avoid).
- The cable for the Adapter is not plenum rated, so it should be routed through conduit when ran through a plenum.
- Do not allow the Adapter to hang from its cord for a permanent installation.
- The Adapter has a 16′ cable. If a longer cable is required, use only those recommended by Acuity Brands. When using extender cables, 120V is required on the Adapter side of the extension. Please see the FAQ for recommendations on extenders when greater than 16′ is needed.
- Never mount the Adapter in an electrical closet.
- Be very mindful of metal – especially large metal equipment, electrical panels, and metal objects hidden within the drywall. These will significantly reduce range in their direction.
- Signal coverage may have gaps when created without a site visit. Using budgetary ranges in Visual™ Controls (an Acuity Brands design tool) and inside of this guide will help to mitigate risk of insufficient coverage.
- Try to avoid high angles of incidences with obstructions. RF is more capable of penetrating an obstruction when approaching it straight on.



4-1 General Operation and Power Requirements

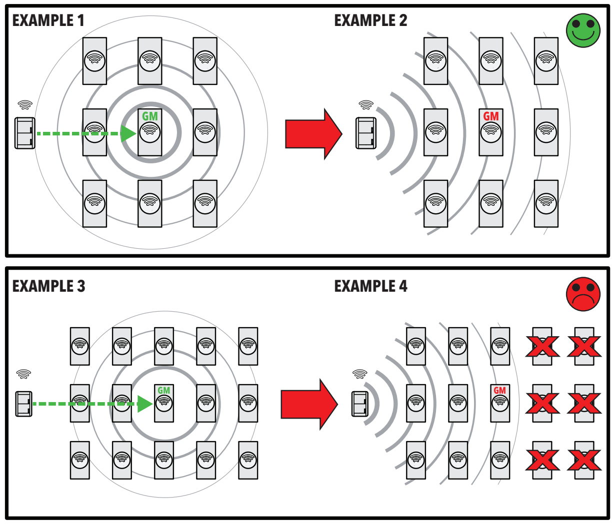
nLight AIR is a distributed-intelligence lighting control system. The nLight AIR parts and pieces communicate with other group members to make decisions based on control inputs. Factors like ambient light conditions, occupancy status, switch presses, and controller commands dictate the light levels in each area. If some or all the nLight AIR devices are not energized, they cannot share control inputs or receive commands to change light levels.

nLight AIR is a system that must be permanently energized.

In retrofit applications, be sure to remove line-voltage switches, line-voltage occupancy sensors, automated contactor systems, and other equipment that may interrupt power to the nLight AIR equipment.

4-2 System Architecture: Stand-Alone Systems

Stand-Alone systems will always have a device assigned as a Group Monitor. Switch and battery powered devices should communicate to the Group Monitor first, which will then broadcast to the rest of the devices. Non-battery/non-switch devices may communicate with a Group Monitor via repeater devices using standalone autonomous bridging. The Group Monitor is typically the center-most fixture or line-voltage device in the group, selected by the CLAIRITY™ Pro mobile application grid placement and will not be a battery powered device. Should the Group Monitor fail, devices will communicate to all of the devices in RF range, but because repeater devices are enabled and managed by the group monitor, they will cease operating as repeaters within 30 minutes of the Group Monitor failing.



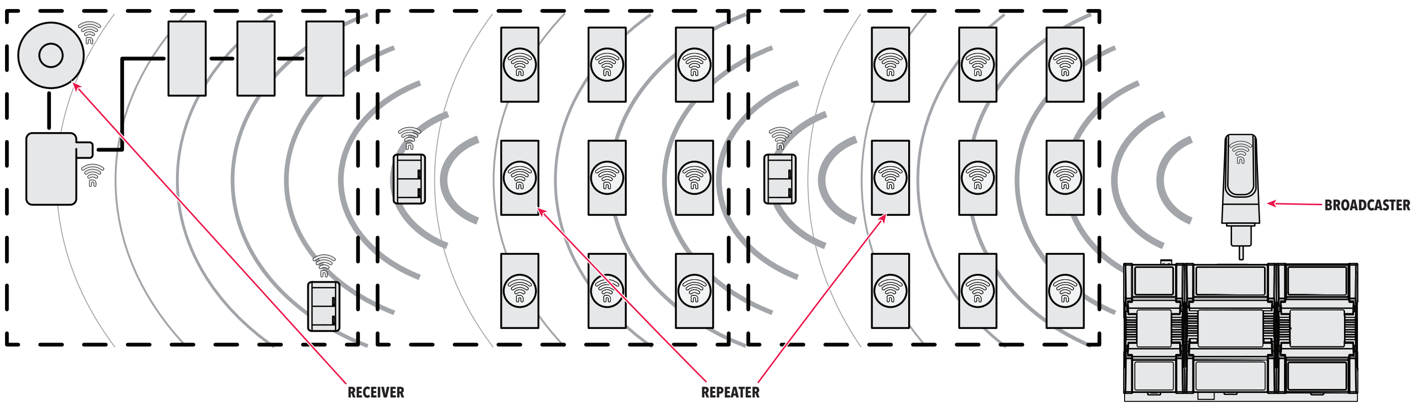
Consider the examples to the right. In example 1, the user presses a wall switch, which communicates to the Group Monitor, which then broadcasts the command to the entire group. In example 2, the Group Monitor does not respond to forward the command, but the devices, still being in the RF range of the broadcasting device, still function as expected. This is considered recommended design practice.

In example 3, again, the user presses a wall switch, which communicates to the Group Monitor, which then broadcasts the command to the entire group. Through standalone autonomous bridging, broadcasts from the Group Monitor could be repeated, too. In example 4, however, the Group Monitor has failed, and since a number of the devices are outside the RF range of the broadcast device, they no longer function as expected. Also because the Group Monitor has failed, repeaters will eventually deactivate and point-to-point communication from the broadcasting device will be the only method of communication.

Therefore, for highest reliability, all devices in the group should be within the RF range of the broadcasting device, and very large groups should not depend on the range of the Group Monitor or standalone autonomous bridging. Though losing the Group Monitor as a point of redundancy will not cause issues for reservedly designed systems, it will make communication between devices less reliable.

4-3 System Architecture: Networked Systems

Consider the example below. There are three groups that have been networked to the same nLight ECLYPSE and Adapter. When messages need to be sent out to the devices, the Adapter communicates directly to the devices through repeater devices by using autonomous bridging technology. It does not necessarily route messages to the Group Monitor as is the case for stand alone applications.



4-4 System Architecture: Global Channel Best Practices

Global channels allow for greater versatility in nLight AIR systems. Please consider the below when using global channels for communication between nLight Wired and nLight AIR devices or when using global channels for communication between nLight AIR groups.

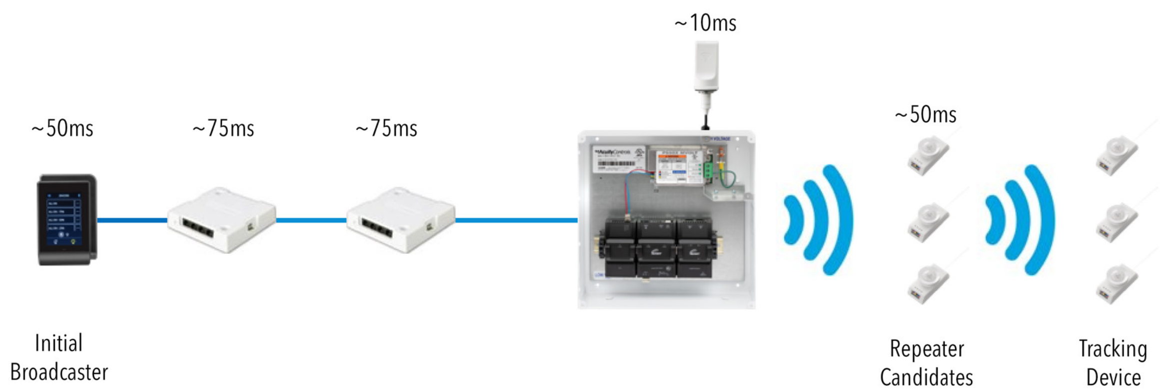
Features of Global Channels for AIR

- Intra-ECLYPSE switch, occupancy, and automatic daylight control dimming broadcasts
- Inter-ECLYPSE switch, occupancy, and inhibit photocell broadcasts
- Ability to control output devices in multiple groups or on different ports from one or more broadcasting devices

Wired to AIR or AIR to Wired

- Do not exceed more than two nLight Wired bridges (nBRG 8 devices) between the nLight ECLYPSE and the furthest Wired device. Each nBRG 8 device adds ~75ms of latency between the nLight ECLYPSE and the end device.
- Repeats via autonomous bridging should be minimized to reduce latency. Each broadcast by an AIR repeater or Group Monitor will cause ~50ms of latency.
- For personal spaces (such as private offices), the sum of all latency caused by nBRG 8 devices, Group Monitors, and AIR repeaters should not exceed ~150ms. For this reason, global channel control of personal spaces is not recommended. Local control should be the basis of design.
- For medium-sized spaces (such as open offices and conference rooms), the sum of all latency caused by nBRG 8 devices, Group Monitors, and AIR repeaters is not recommended to exceed ~250ms.
- For large spaces (such as gymnasiums, warehouses, cafeterias, outdoor areas, and long corridors), the sum of all latency caused by nBRG 8 devices, Group Monitors, and AIR repeaters is not recommended to exceed ~500ms.
- It is not recommended to have both Wired and AIR output devices follow the same broadcasting device in small or medium spaces. This is due to a ~150ms to ~250ms latency difference in messages received by the Wired and AIR devices, likely to result in asynchronous response.
- For best performance, systems that use global channels should not make regular use of global profile scenes and numerous scheduled profiles. Profile transmission by the nLight ECLYPSE takes priority over channeling, which will delay the rollout of a global channel.

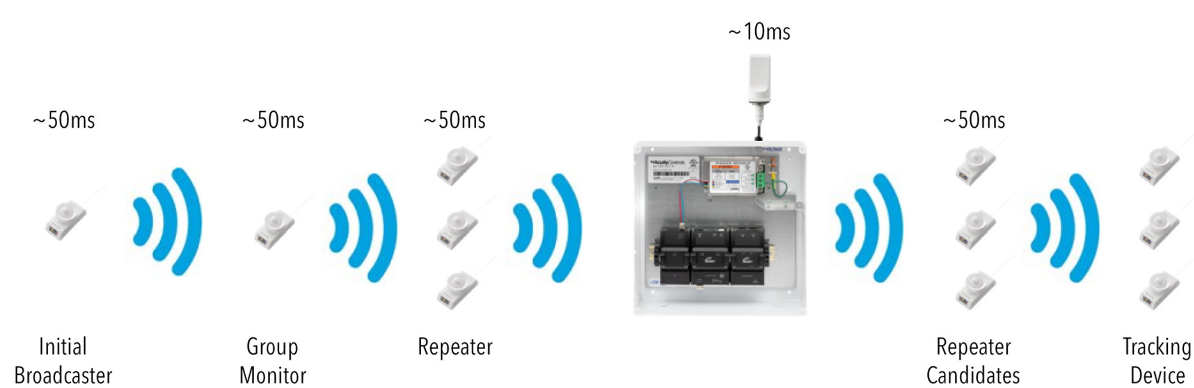
- Global preset scene control of AIR output devices is not supported. Global preset scenes cannot be broadcast by AIR devices to affect Wired devices.
- Global profile scenes can be triggered by Wired devices to control AIR devices. However, profiles are issued by an nLight ECLYPSE through unicast messages (issued consecutively to one device at a time, quickly), which may result in asynchronous response from output devices. This differs from broadcast messages, which result in uniform response from output devices.
- Global channels for Wired to AIR messages are only available for systems that do not make use of nGWY2 system controllers or the Virtual WallPod plugin for SensorView.



Estimated Latency: ~260ms

AIR to AIR

- Repeats via autonomous bridging should be minimized to reduce latency. Each broadcast by an AIR repeater or Group Monitor will cause ~50ms of latency.
- For personal spaces (such as private offices), the sum of all latency caused by Group Monitors and AIR repeaters should not exceed ~150ms. For this reason, global channel control of personal spaces is not recommended. Local control should be the basis of design.
- For medium-sized spaces (such as open offices and conference rooms), the sum of all latency caused by Group Monitors and AIR repeaters is not recommended to exceed ~250ms.
- For large spaces (such as gymnasiums, warehouses, cafeterias, outdoor areas, and long corridors), the sum of all latency caused by Group Monitors and AIR repeaters is not recommended to exceed ~500ms.
- For best performance, systems that use global channels should not make regular use of global profile scenes and numerous scheduled profiles. Profile transmission by the nLight ECLYPSE takes priority over channeling, which will delay the rollout of a global channel.
- Global channels for AIR to AIR messages are only available for systems that do not make use of nGWY2 system controllers or the Virtual WallPod plugin for SensorView.



Estimated Latency: ~210ms

5-1 Frequently Asked Questions

- **What is the IP rating of the Adapter?**
  - The Adapter is IP66 rated.
- **What is the temperature rating of the Adapter and nLight ECLYPSE?**
  - The nLight ECLYPSE is rated 0 to 50°C and should be installed in an environmentally controlled area. The Adapter is rated -40 to 65°C and can be installed outdoors.
- **Should the Adapter be mounted outside an electrical or IDF room?**
  - The Adapter should be placed with the fewest obstructions between it and the devices it is controlling. Placing the Adapter outside an electrical or IDF room – such as in a hallway – is required and will allow the Adapter to communicate farther through the space.
- **Should the Adapter be mounted to a wall? From the ceiling?**
  - The Adapter can be mounted to a wall or from the ceiling. These options are covered in the installation instructions. Generally, mounting the Adapter in the center of a room is best.
- **How do I extend the Adapter from the nLight ECLYPSE?**
  - The Adapter includes a 16 foot cable, but extension cables are available that can extend the Adapter an additional 150 feet. An extender can be ordered using Acuity Brands part number NECYD EXT150 (CI Code - *268NEC).
- **Can signals go through walls?**
  - RF can penetrate many different types of obstructions. However, some wall materials reduce the signal strength more than others. Dry wall is penetrated more easily. Metal, reinforced concrete, and materials generally used on the exterior of a building (such as brick) are difficult to penetrate. As identified in the design section, relying on line-of-sight communication, then reflections, and lastly penetration will reduce the chance of insufficient signal strength.
- **Can I use more than one Adapter per nLight ECLYPSE?**
  - Each nLight ECLYPSE can support only one Adapter at this time.
- **Does RF go through glass?**
  - Yes, however glass with re-enforcing wire or low-E coating/film will reduce the RF more than regular glass.
- **Can signals reflect to avoid a large obstruction?**
  - Yes, however, each material has different characteristics for signal absorption and reflection. Some materials may reflect more RF than others.
- **Should I use the Adapter to communicate to devices on separate floors?**
  - One Adapter should be used per floor. RF will not reliably penetrate the heavier-than-average construction required between floors.
- **Can indoor and outdoor be in the same group? Or on one nLight ECLYPSE?**
  - It is recommended to use a separate nLight ECLYPSE and Adapter for the exterior and interior, unless the site is a retrofit or renovation where a site survey can be done to confirm reliable RF communication across an exterior wall. See the below for more information. Penetrating an exterior wall of a building is difficult and significantly reduces RF range, so for a reliable connection and more range, separate nLight ECLYPSE controllers and Adapters are always needed for new construction.
- **If working on a retrofit or renovation project and a site survey can be performed, is it possible to test and verify if a single nLight ECLYPSE and Adapter can be used for both indoor and outdoor communication?**
  - Yes, it is possible to test and verify that a single Adapter can communicate with indoor and outdoor devices for retrofit or renovation applications by using a site survey kit (NLTAIR SURVKIT - CI Code *2640U9). When using an indoor mounted Adapter to control outdoor fixtures or vice versa, one hop is expended when broadcasting through an exterior wall, leaving the remaining hops for additional communication and distance.
- **What are some examples of significant obstructions?**
  - Metal - metal equipment, metal-sided buildings, chain-link fence, wire mesh re-enforcement beneath stucco, re-enforcing wire in windows in doors, large electrical panels, and metal HVAC ducts.
  - Mirrors – Large mirrors are significant obstructions as they reflect RF.
  - Exterior walls – brick, cinder block, and concrete.
  - Stairwells – typical construction of a stairwell.
  - Electrical rooms, IT rooms, and Mechanical rooms – made of various constructions that generally impede RF.
- **What is the part number for an Adapter?**
  - The Acuity Brands part number is NECYD NLTAIR G2 (CI Code - *263L26). It is most often paired with the MVOLT version of the nLight ECLYPSE with an enclosure, NECY MVOLT ENC (CI Code - *261WY0).
- **How do I determine in the field if my Adapter placement is ideal?**
  - By using the CLAIRITY™ Pro application, signal strength between the Adapter and receiving devices can be measured. Instructions on measuring signal strength can be found in the Clairity Pro user guide under Troubleshooting Tools, or they can be found in the nLight AIR Site Survey Kit's instruction guide.

