

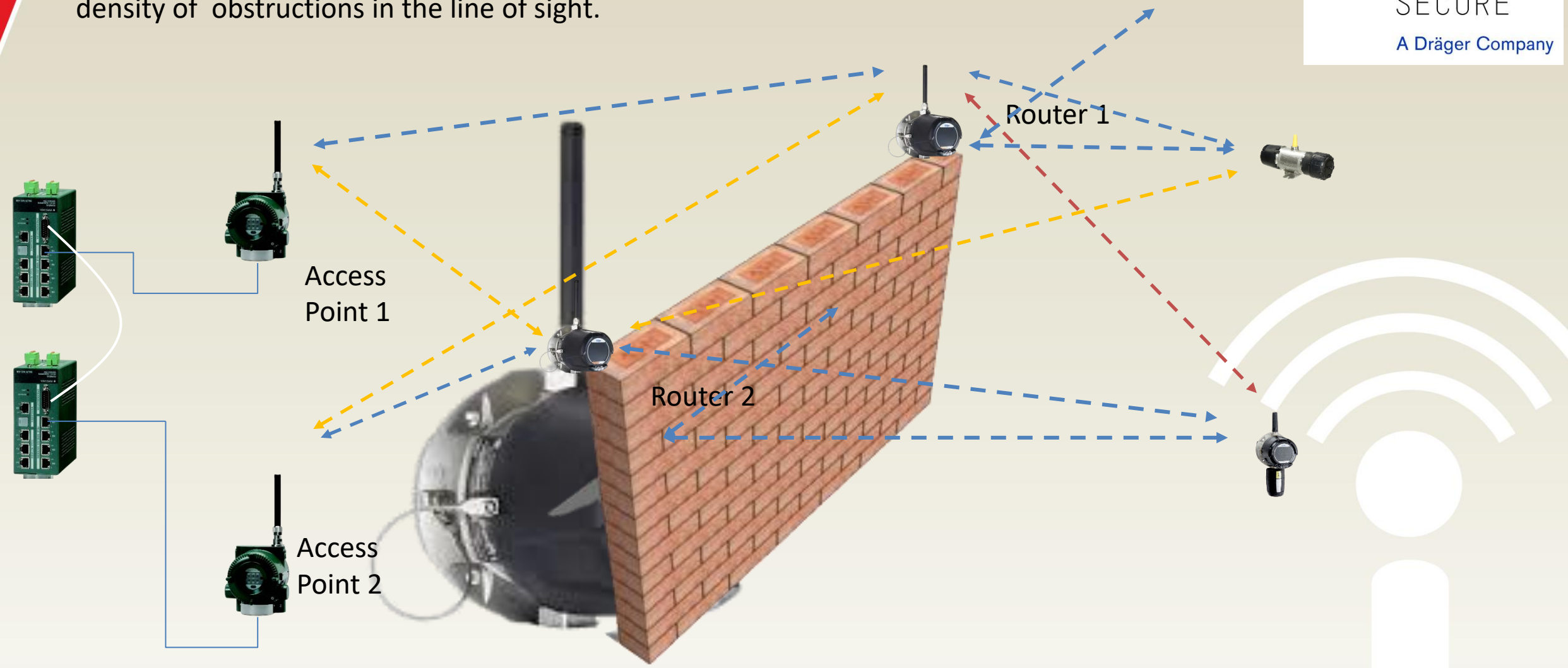


ISA100 Wireless Training: Galveston, Texas

A guide to set up networks for ISA100

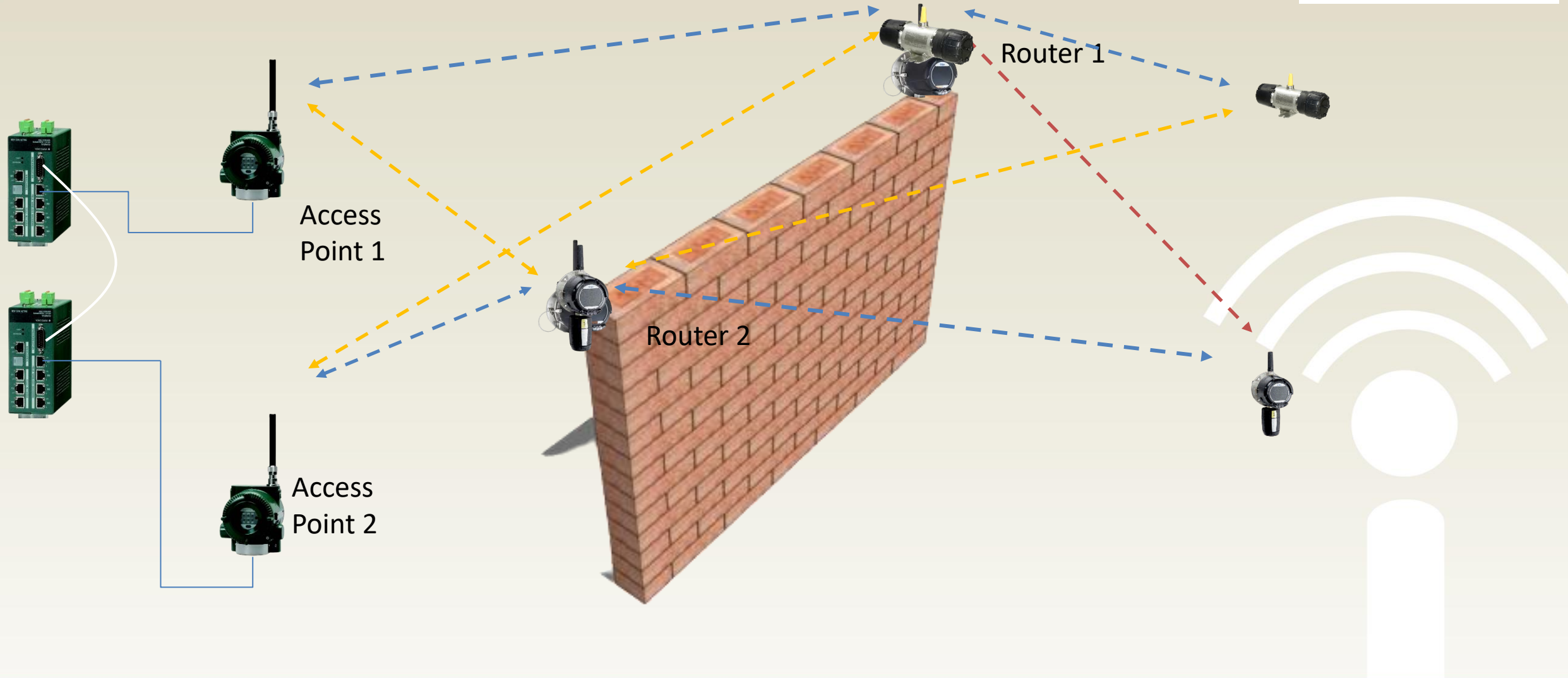


Adding battery driven routers for long range communication or for areas with too high density of obstructions in the line of sight.

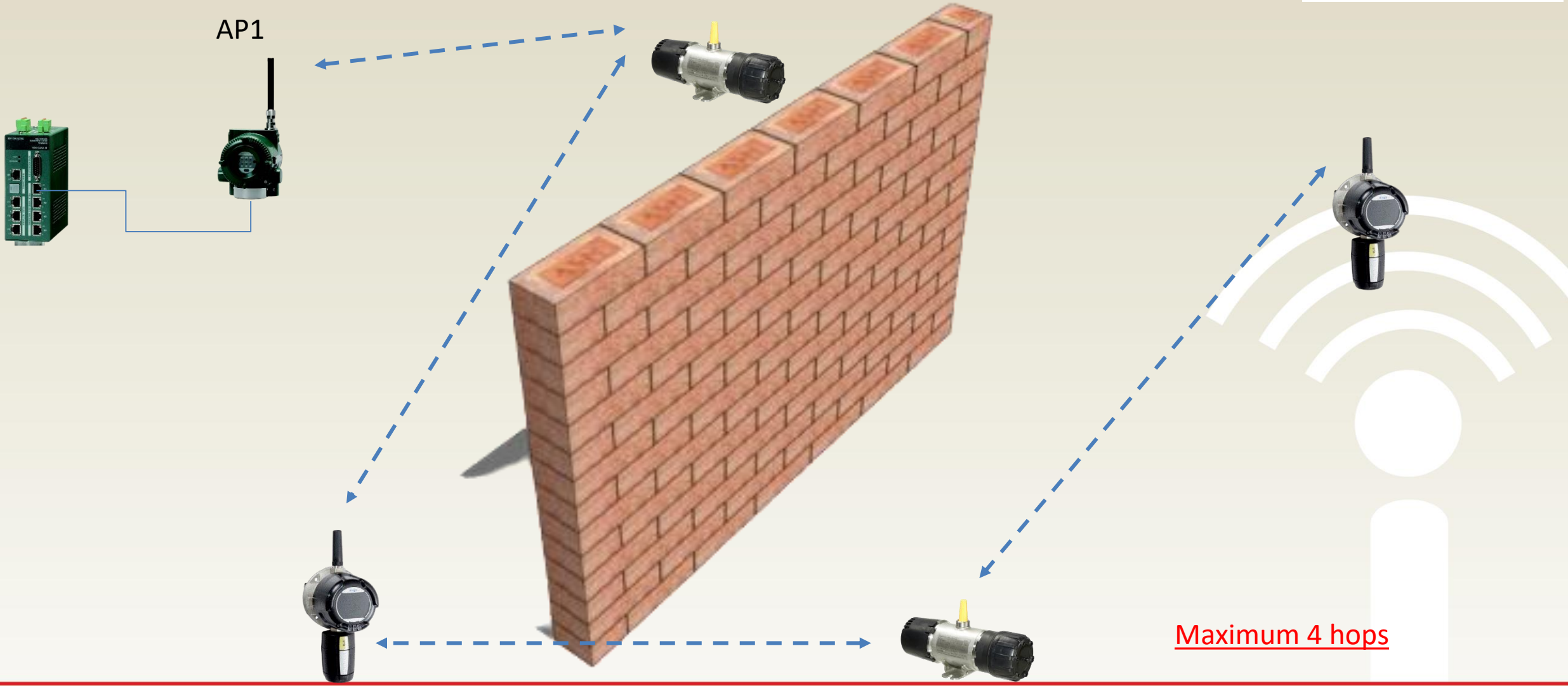


It is recommended to not have more than 15 detectors connected through each router.

Using an detector can be used as a router

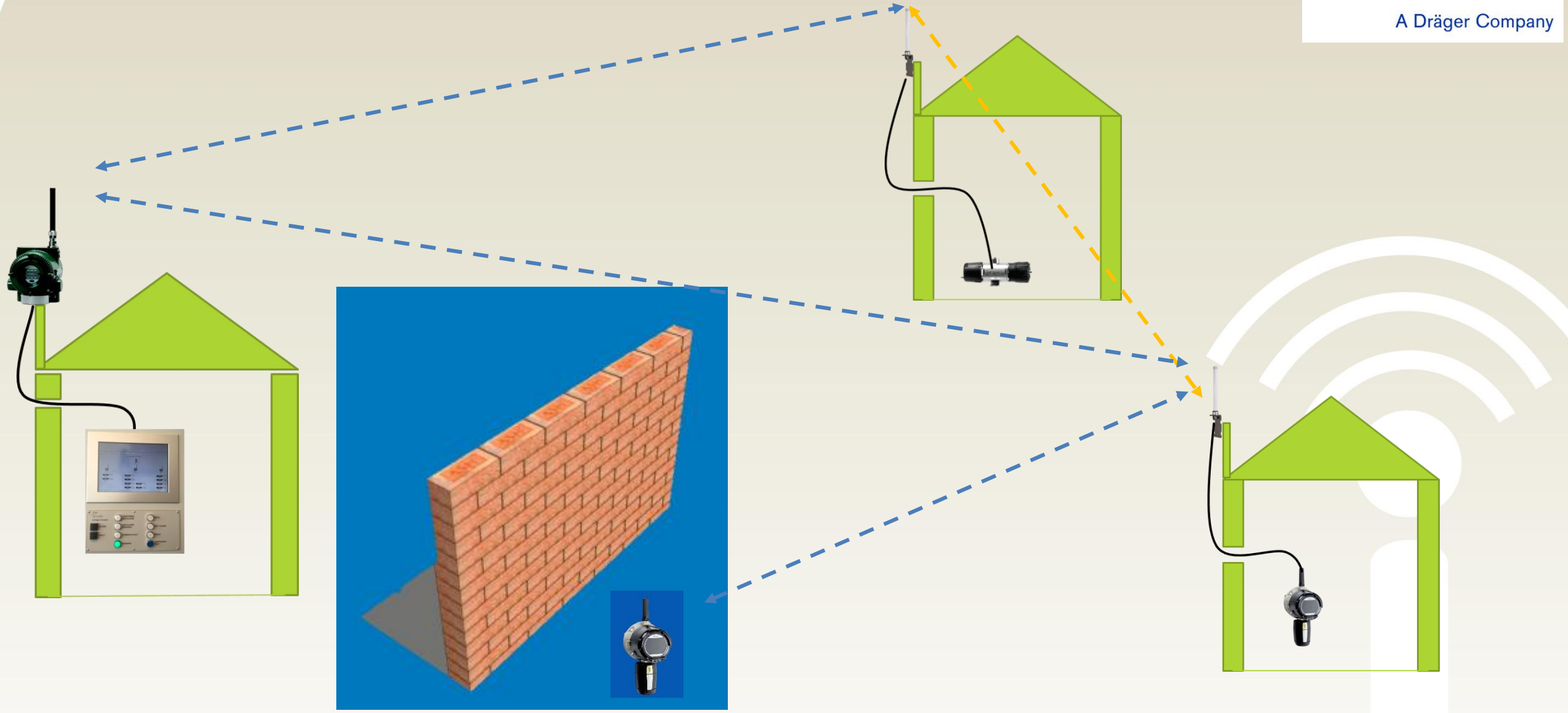


Jumping between detectors



Maximum 4 hops

Using the extended antenna



Wireless communication and Fresnel zone

The communication distance and quality of radio signals is affected by:

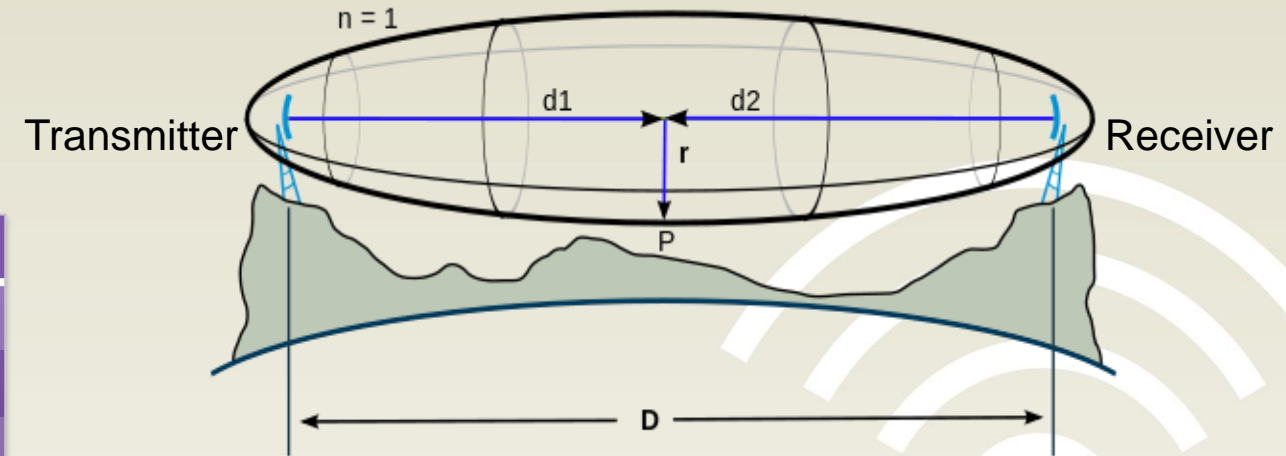
Chose of antenna type, obstructions in the area and antenna location height.

Fresnel zone = Elliptical area(radius) around line of sight (LOS) line between two antennas.

Clearance radius r [m]	Communication range D [m]
4.0	500
3.0	288
2.0	128
1.5	72
0	50

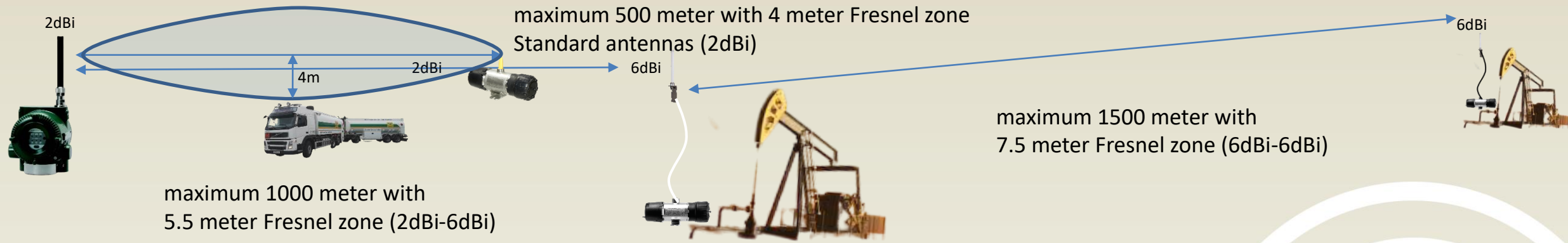
2x standard 2dBi antennas in open area.

According to the table the antennas should be placed at 4 meter above ground to achieve 500 meters communication length on a flat surface



Reflective objects placed within the edges of the zone will affect radio communication.

Communication distance and installing height of the wireless infrastructure



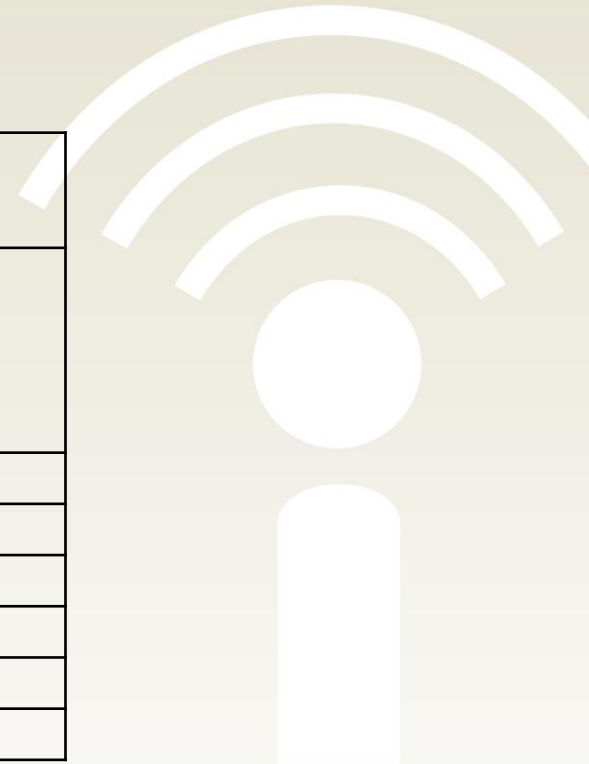
maximum 1000 meter with 5.5 meter Fresnel zone (2dBi-6dBi)

maximum 500 meter with 4 meter Fresnel zone Standard antennas (2dBi)

maximum 1500 meter with 7.5 meter Fresnel zone (6dBi-6dBi)

Combinations of antennas	Antenna location height	Distance (m) Open area	Distance (m) Minor obstacle area	Distance (m) Heavily obstructed area
2dBi-2dBi	4.0	500	250	50
	3.1	300	150	
	1.8	100	50	
	0.5	--	50	
2dBi-6dBi	5.5	1000	--	--
	5.0	800	--	--
	4.5	600	--	--
6dBi-6dBi	7.5	1500	--	--
	6.5	1250	--	--
	5.5	1000	--	--

Open areas: Areas where line of sight (LOS) are unobstructed



OPTIONS COMMUNICATION BETWEEN GATEWAY AND ACCESS POINT



toughCat.5 or other suitable ethernet cable

BFOU 2X1,5 mm² or other suitable cabl for power.

24VDC (145mA)



Ethernet Cat.5 max 79 meter.
power from any 24VDC UPS source.



Hybrid-cable Cat.6 4x2xAWG26/7,4x1,5;



Ethernet Cat.6 and power in one cable.
Max. length 100 meter

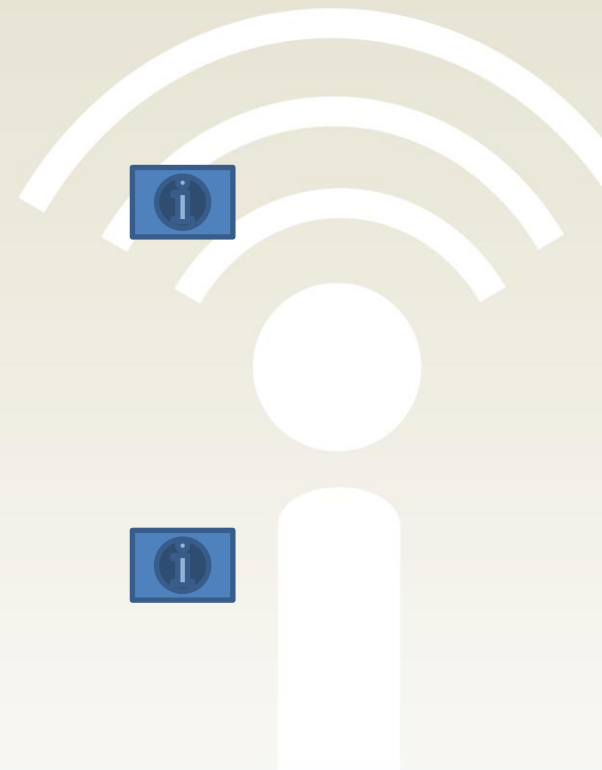


Dual/single fiber cable

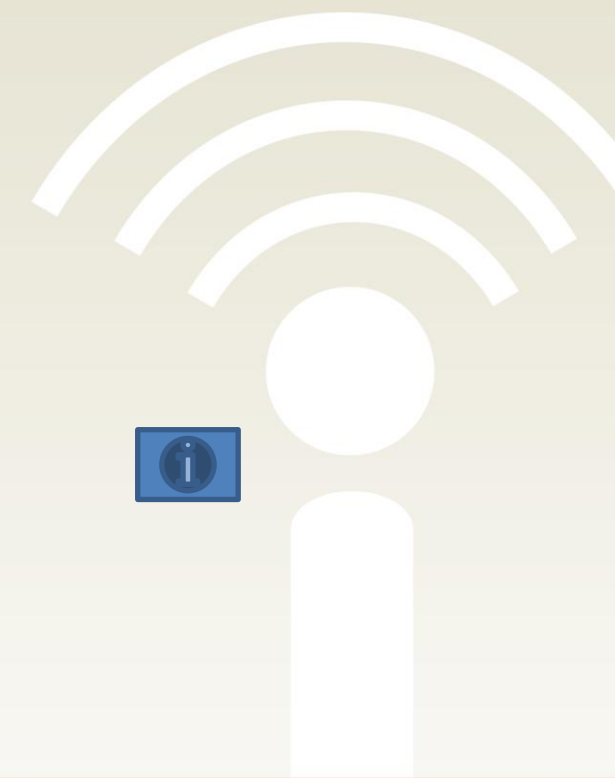
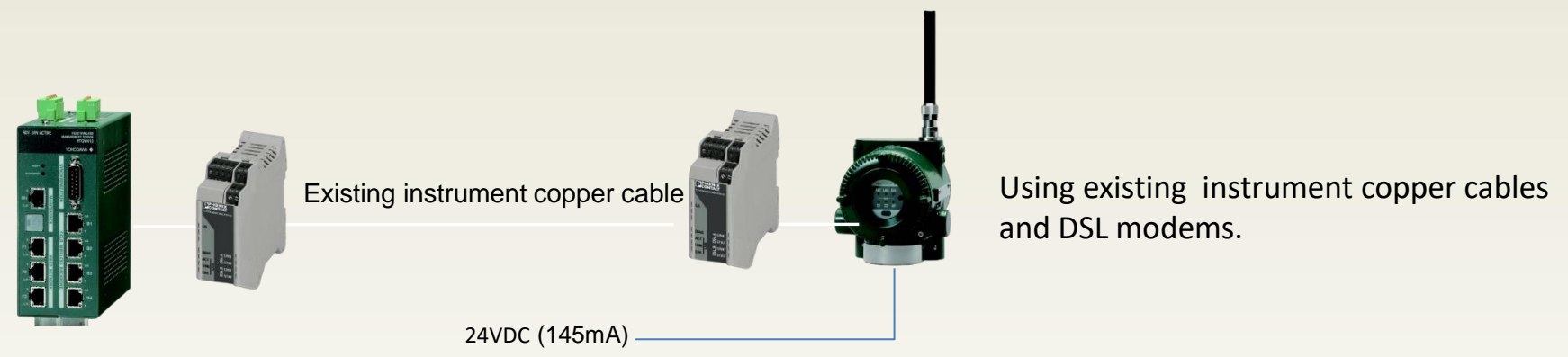
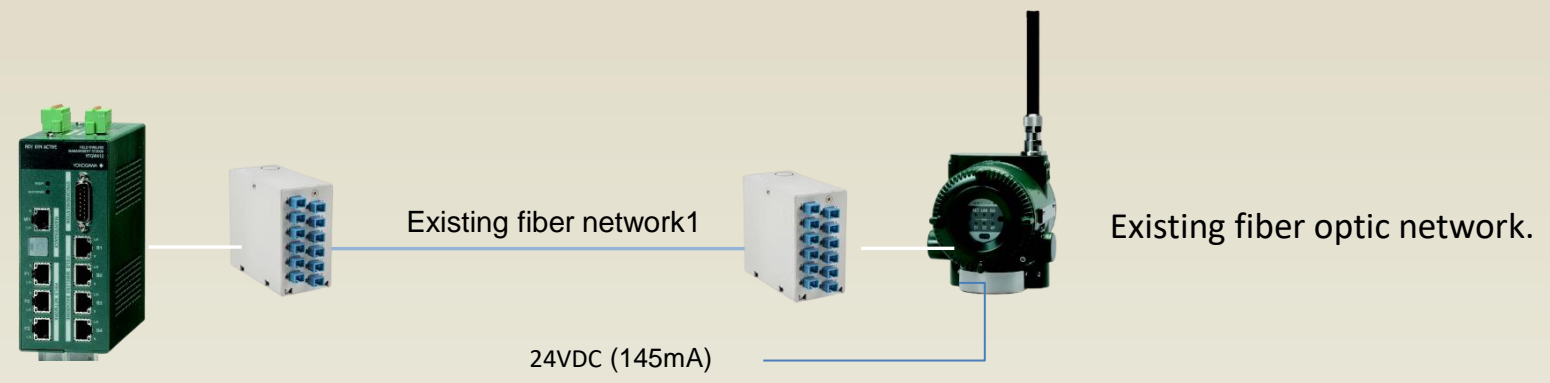
24VDC (145mA)



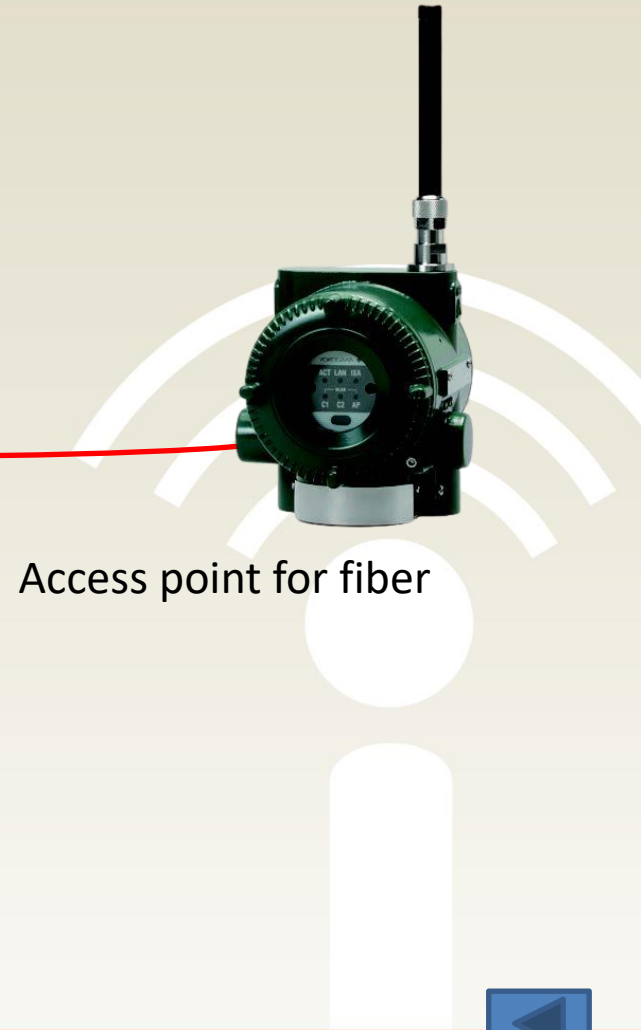
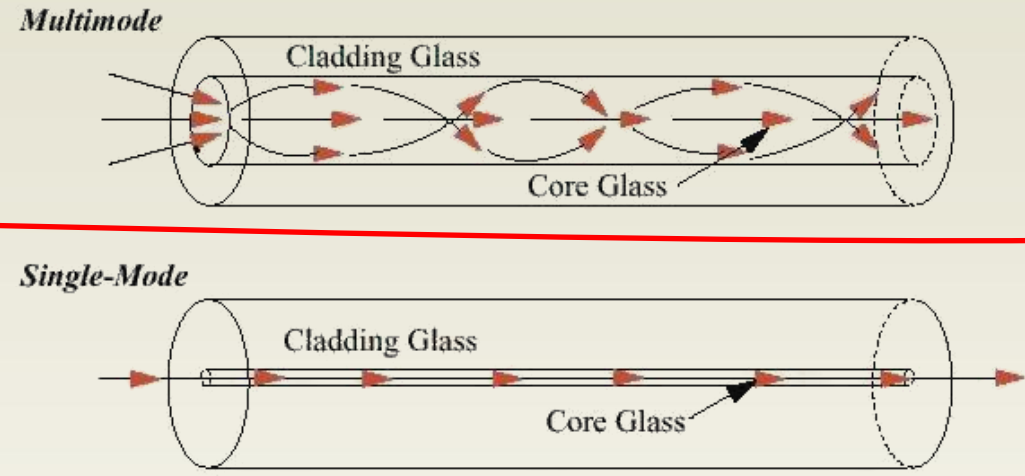
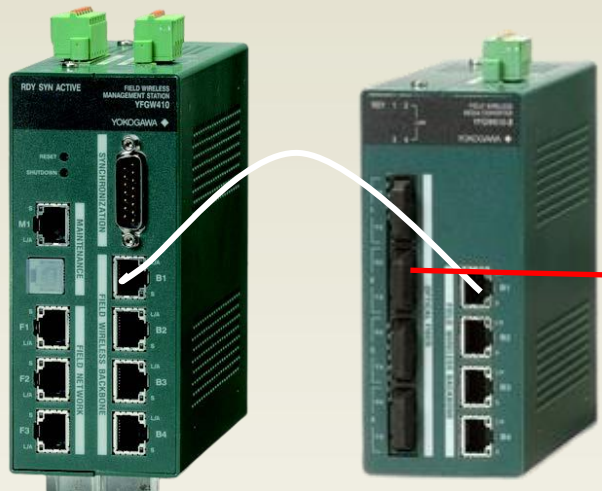
Fiber cable.
Max. length 2000/5000 meter



OPTIONS COMMUNICATION BETWEEN GATEWAY AND ACCESS POINT



Fibre optic connection



Yokogawa YFGW Media converter

Fiber maximum length is 2000 meter with multi mode fiber or 5000 meter with single mode fiber.

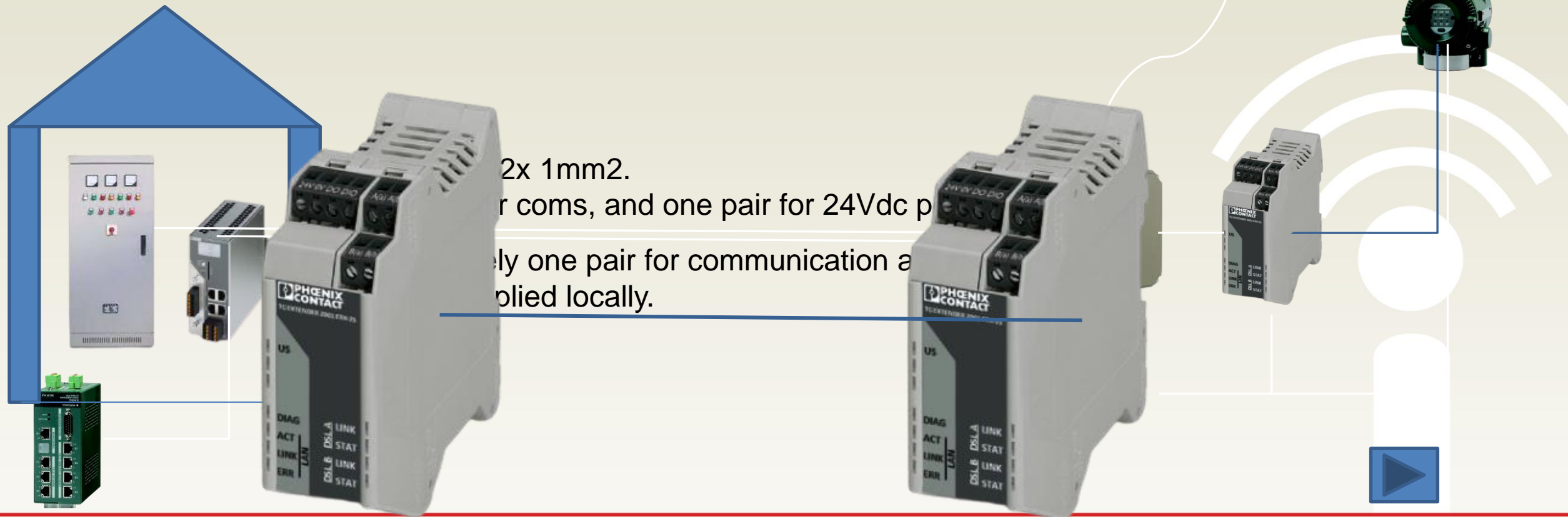


The Ethernet extender makes broadband Ethernet applications on existing cables possible.

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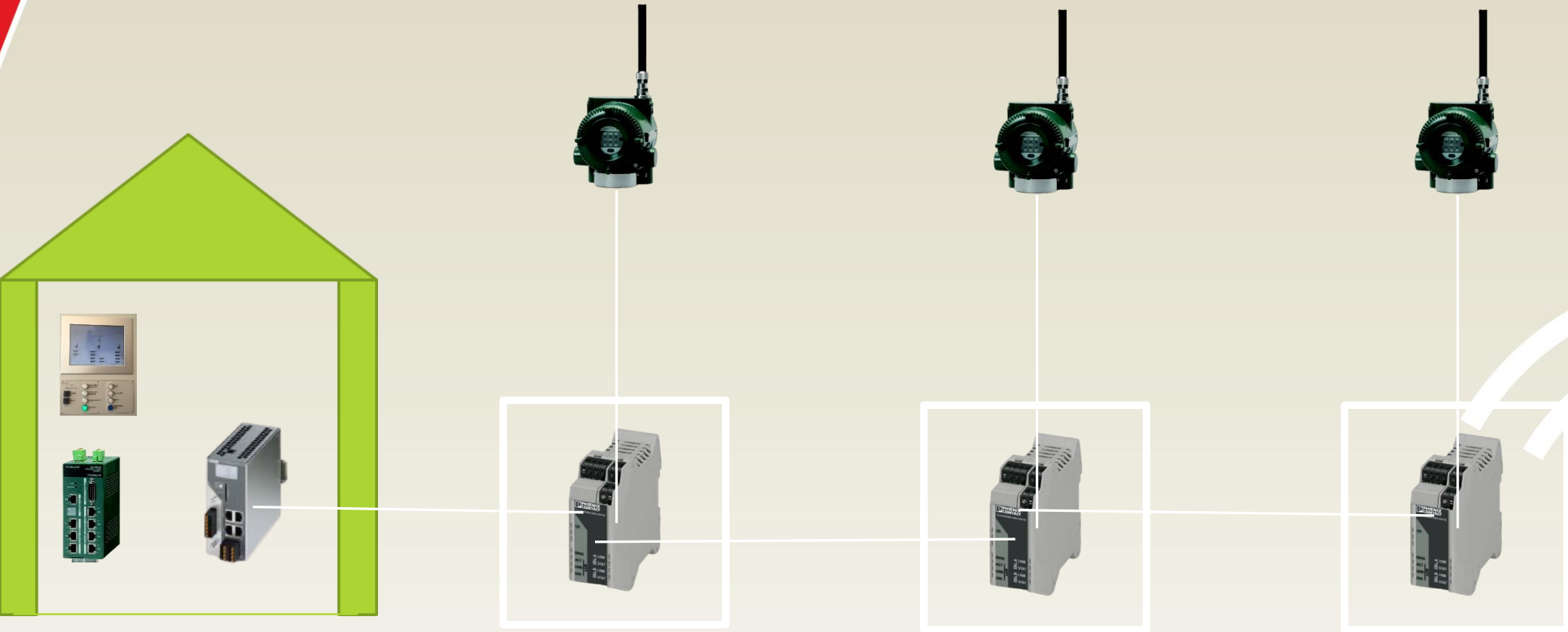
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This means it is possible to use spare cable or reuse cables from existing old gas detectors/other instruments to build a network for multiple access points. The customer can add many dozens of new detectors this way.



2x 1mm².
 for coms, and one pair for 24Vdc p
 ly one pair for communication a
 plied locally.

DSL daisy chain



Exd/Exd enclosure

Exd/Exd enclosure

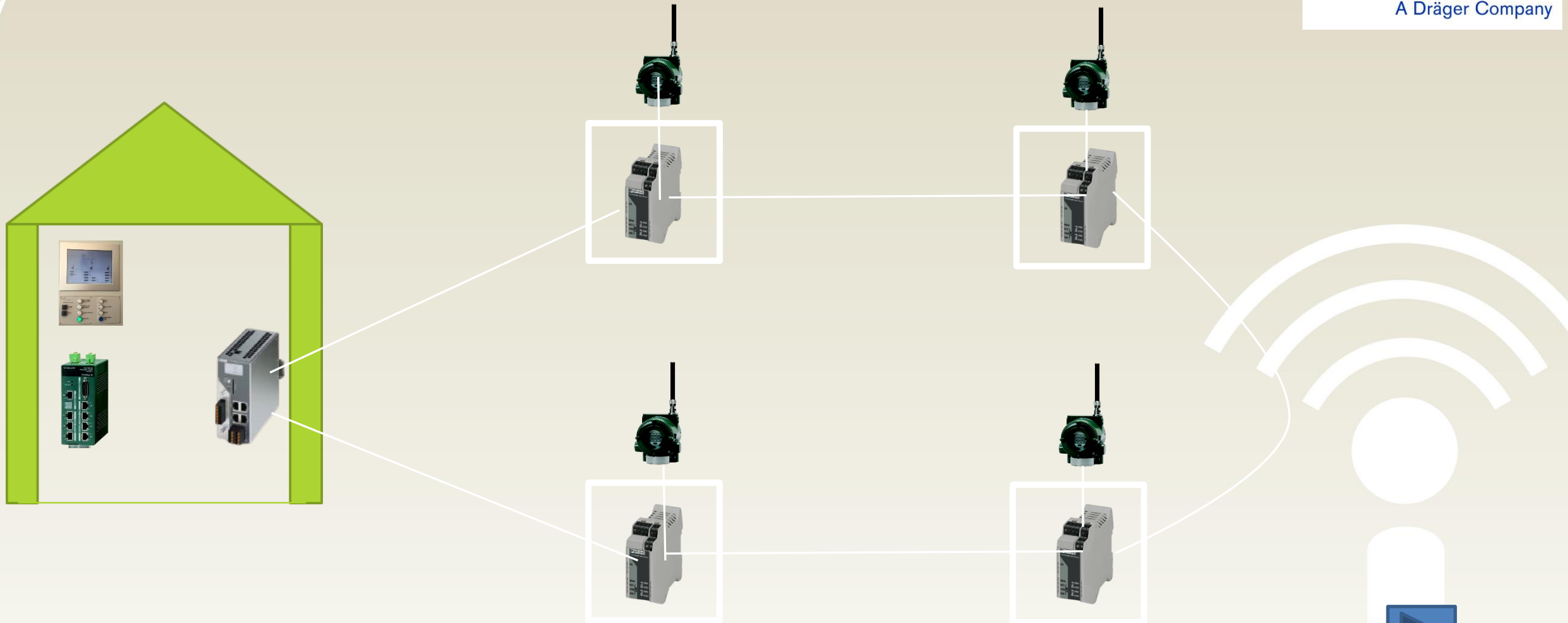
Exd/Exd enclosure

The DSL modem is approved for Ex zone 2 but should be installed in an Exd enclosure. (Depends on the site shutdown philosophy)

If installed in an Exd enclosure, it can of course be installed in zone 1 as well. It is now easy to further expand the DSL network to connect up to four access point in a "line configuration".

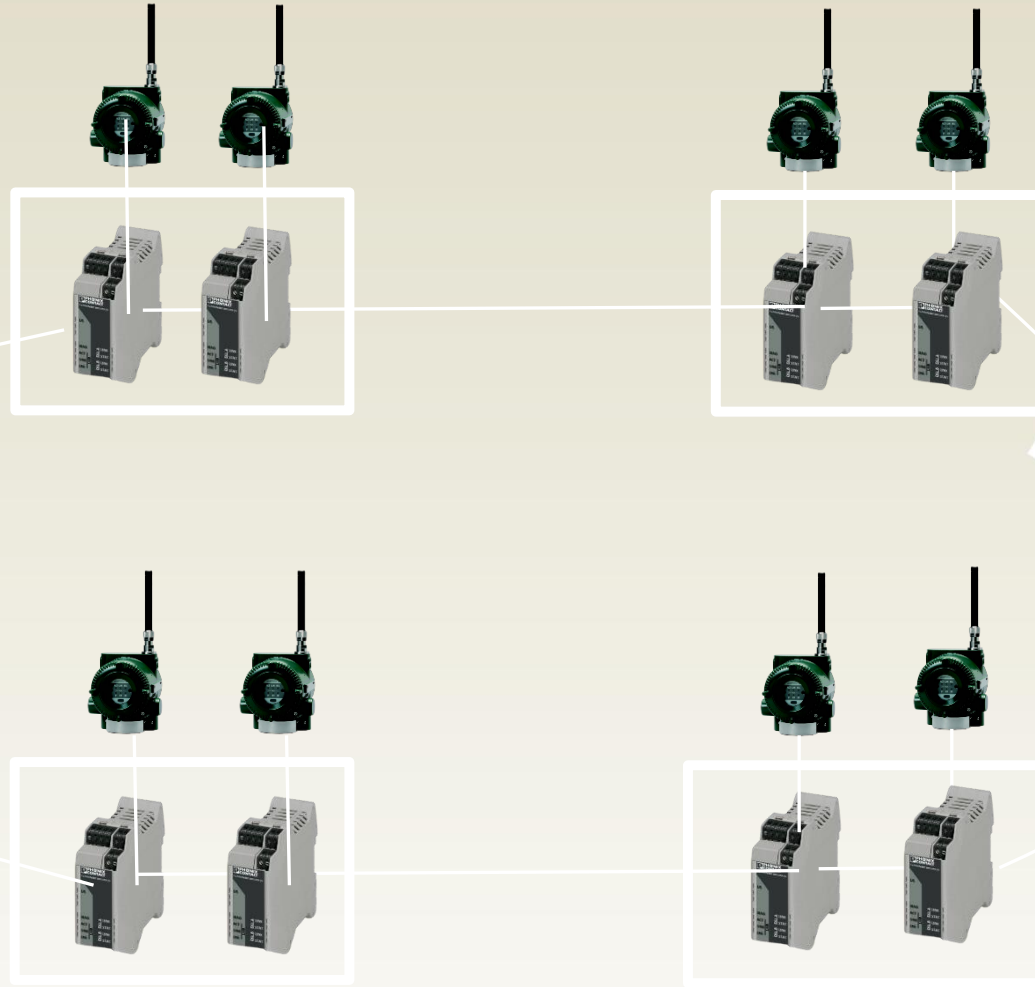
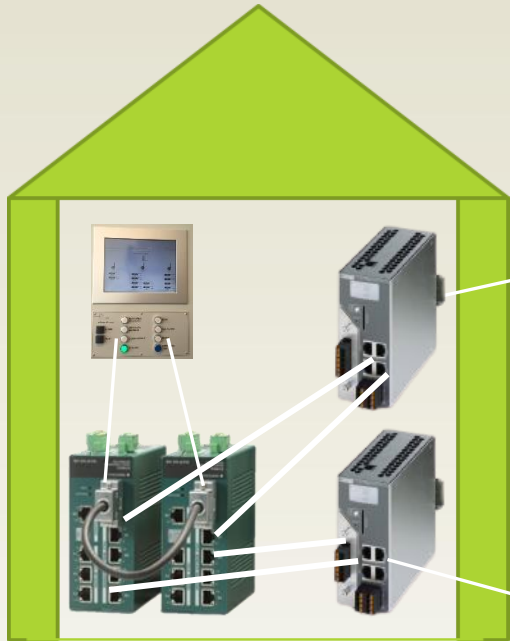


The DSL modems can be sat up in star configuration as well.



Add a connection between DSL's in the end of the lines to make the DSL network redundant.

Example on total redundancy with DSL-modems:



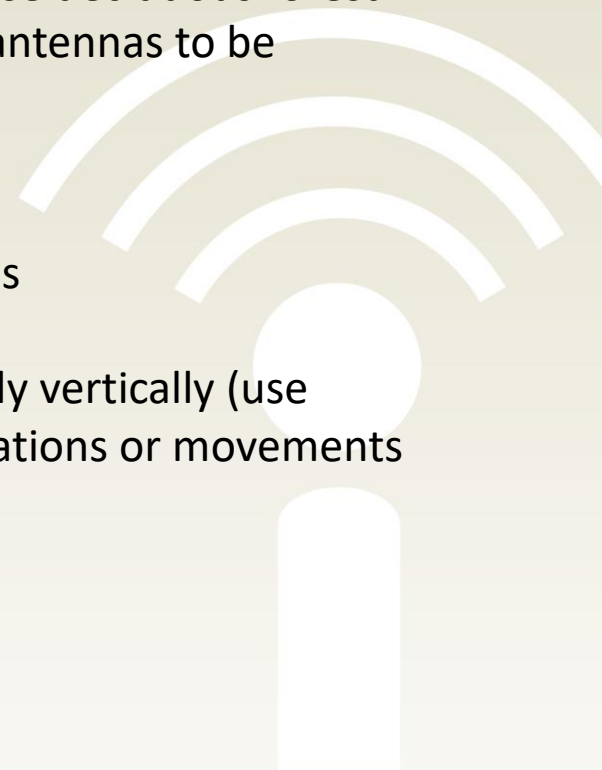
Read more about managed TC extender [HERE](#) and un-managed TC extenders [HERE](#).



Installing antennas

The following recommendations apply to all antenna installations onshore where long communication paths occurs:

- Install the antenna in an open area as far away from any obstacles such as buildings, dense deciduous forest or metal objects. Select a location that ensures a free signal path in the direction of the antennas to be connected to.
- If two antennas are located in the same place, the distance between them should be at least 0.5 m in the vertical direction and 1 m in the horizontal direction.
- Make sure that you select the correct antenna characteristics at both ends of the wireless path. You can also combine omnidirectional antennas and directional antennas.
- It is very important that the antenna for long range communication is installed completely vertically (use spirit level) and on a sturdy pole or bracket which can withstand winds and or other vibrations or movements in the surroundings.
- Keep the connection between the wireless module and the antenna as short as possible. Every extension or adapter cable (pigtail) will cause higher attenuation.



Installing antennas

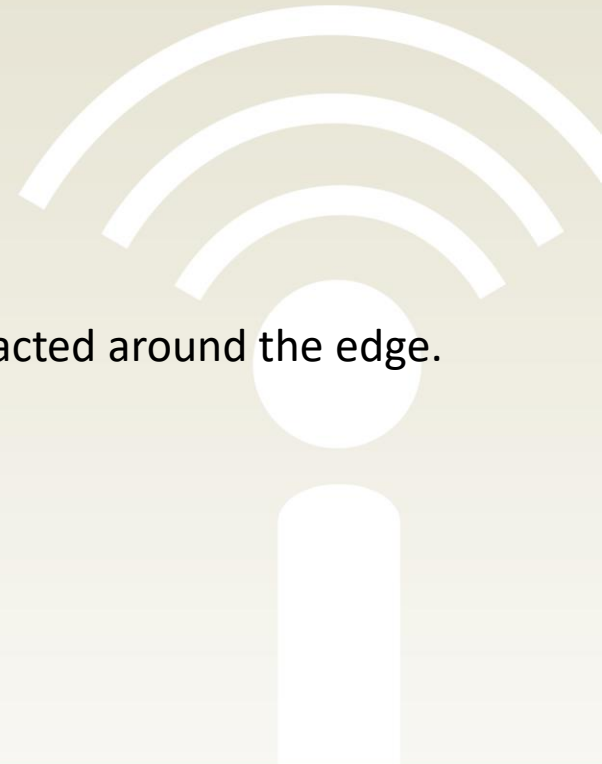
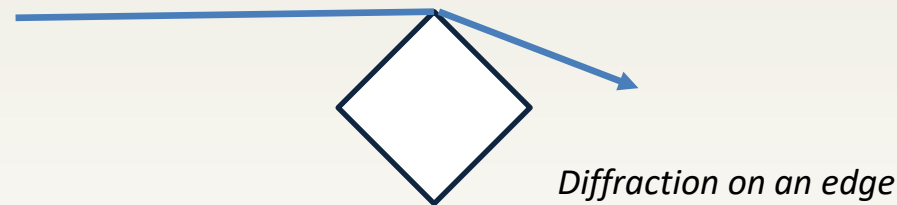
In addition to free space attenuation, there are other factors which influence the wireless path.

Dispersion, diffraction, and reflection represent types of interference that occur when the wireless signal encounters obstacles. They result in multipath propagation.

- Dispersion of the wireless signal, e.g., at a wooden pole, means that the wireless signal is dispersed in several directions.

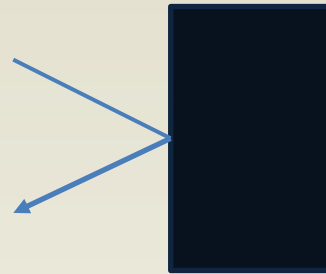


- Diffraction of the wireless signal, e.g., on edges and obstacles, involves the signal being refracted around the edge. The signal then changes its direction. This is similar to the refraction of light in a crystal.



Installing antennas.

- Reflection on a smooth metal surface involves virtually the entire wireless signal being reflected at the same angle. In most applications, the reflection have a positive effect, e.g., if there is no line of sight.



Reflection on a metal surface

Reflections from metallic surfaces are a necessity where LOS does not exist between detector and router/access point. (within approximately 50-meter radius)

An installation of wl detectors on an offshore process platform, is considered easier than an installation on e.g., a tank farm, were most of the surroundings are concrete and dirt.

Metallic round tanks may diffract the wireless signals. LOS in combination with antennas installed perfectly vertically on sturdy poles is very important where distances are bigger and were there is lack of good reflections.

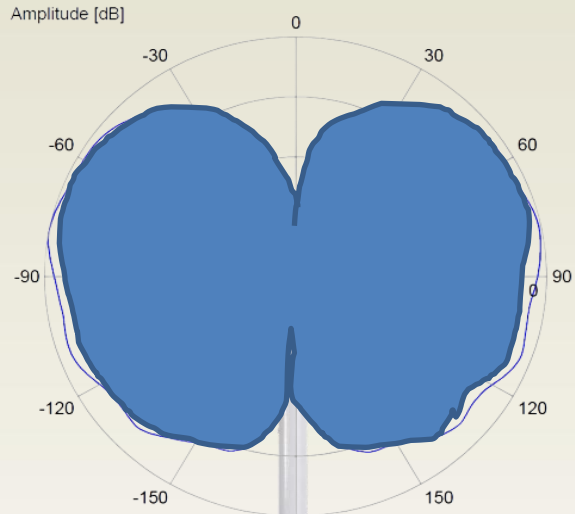
Antenna profiles and installation height.

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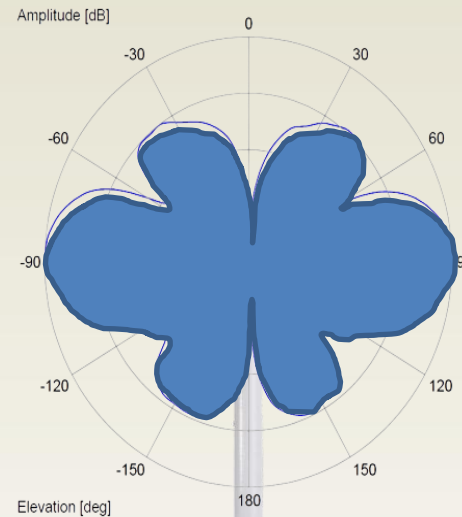
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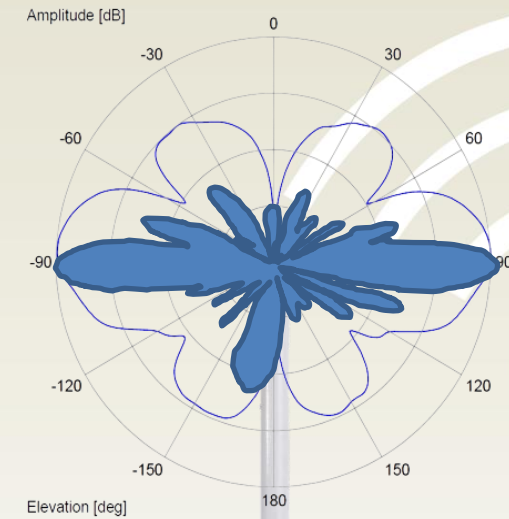
When choosing antennas with regards to communication length, the 2- and 6 and 9dBi antennas have a different radiation pattern. The standard 2 dBi antenna has between up to 90 degrees vertical beam with, whilst the 6 dBi has up to 30 degrees and the 9 dBi has only 10 degrees. A repeater or access point with a high gain antenna installed at height, have limited coverage for detectors installed beneath depending on height difference(angle) and reflections/lack of reflections from the surroundings. It is important to choose the right antenna, big is not always better.



2dBi
Up to 90 degrees
beam width



6dBi
Up to 30 degrees
beam width

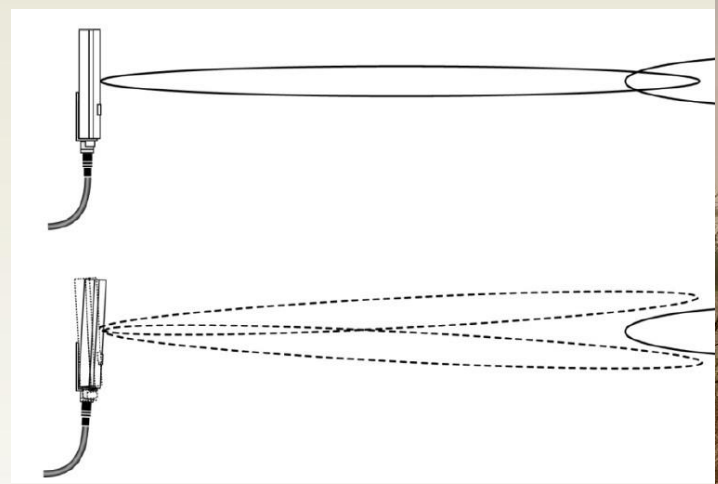


9dBi
Up to 10 degrees
beam width

Weather influences

Snow, rain or hail only have a small effect on a square meter, i.e., a cloudburst, attenuates a signal at 2.4 GHz, for example.

Strong wind does not influence the velocity of the signal, but the antenna must be securely fixed in place. Especially at a large opening angle, you should make sure the antenna is fixed. Moving the antenna away from its original position results in a partial loss of the wireless signal.

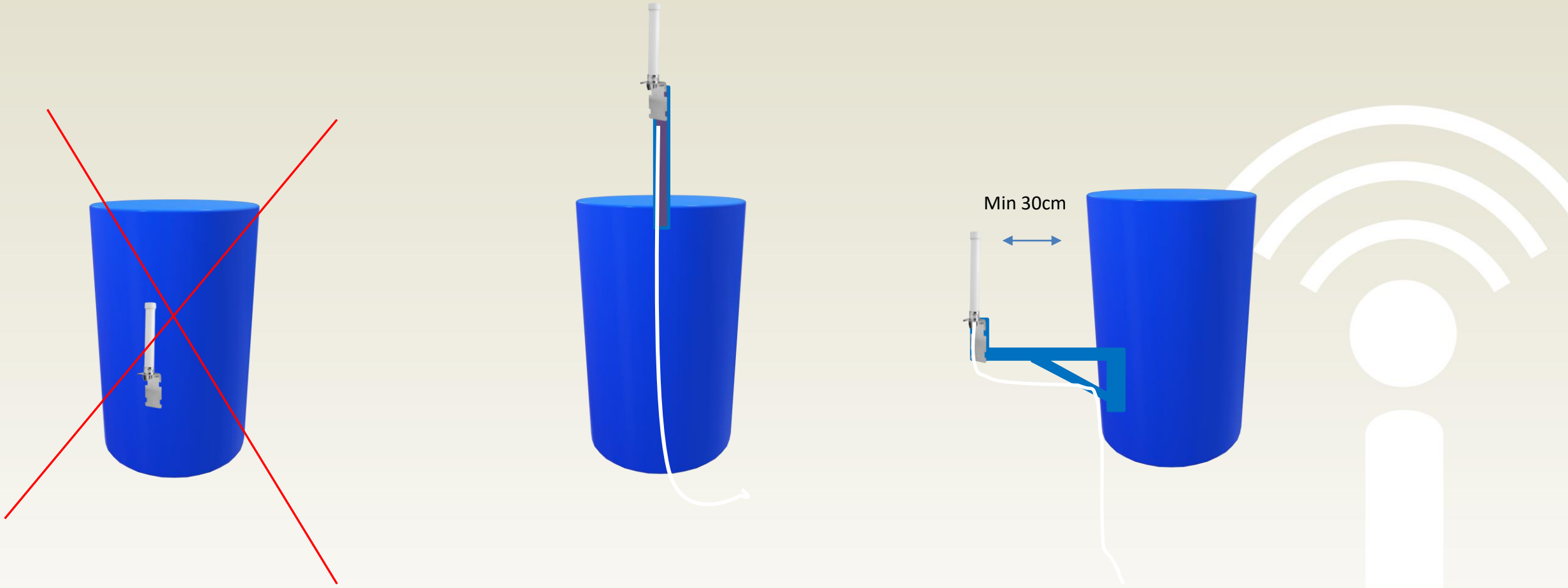


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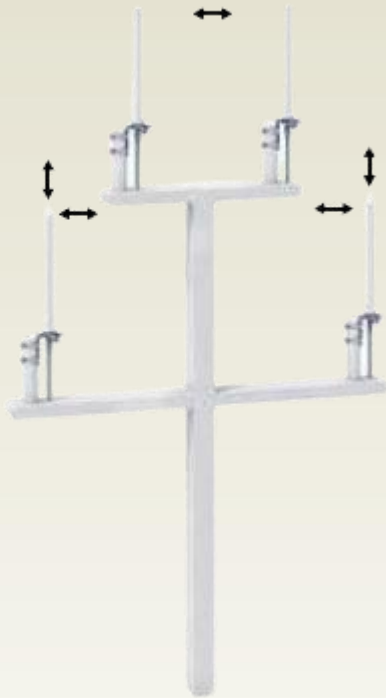
Other installation recommendations

An omni-directional antenna must always be installed at a sufficient distance from obstacles like (poles, building walls or metal walls).



Other installation recommendations

If multiple radio modules are used, you have to make sure the antennas are spread out at sufficient distances from one another.



It is best to install the antennas above each other on a pole.
The minimum distance is 0,5 meter in vertical and 1 meter in horizontal distance.



10 General antenna rules

1. Antenna gain

A high antenna gain does not automatically mean a better connection. The high gain generates a small angle of radiation, which requires a more precise alignment.

2. Antenna selection

Think about selecting the correct antenna characteristics, particularly on the receiver side.

3. Assembly height

An antenna should be positioned as high as possible.

This allows you to improve the range.

This keeps the Fresnel zone clear – the higher, the better.

4. Antenna cable as short as possible

The antenna cable should be as short as possible to keep signal loss on the cable as low as possible.

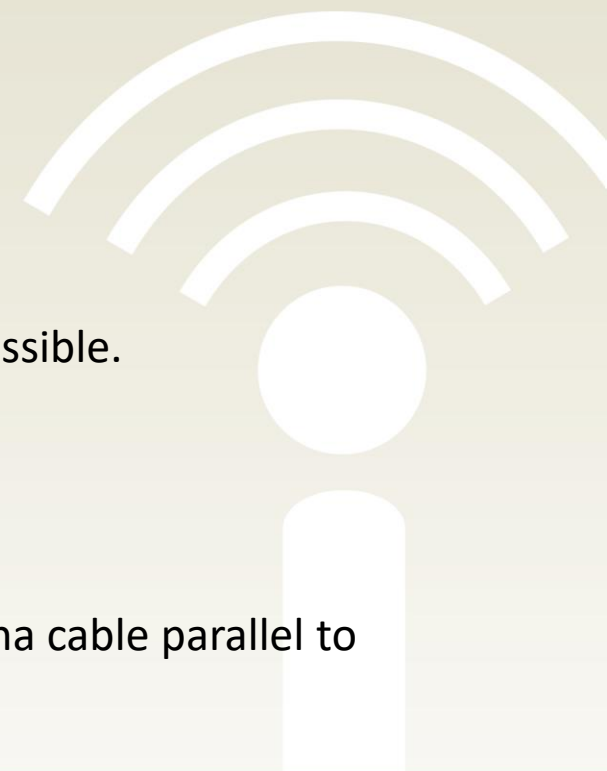
5. Always protect connections on the outside cables,

junctions and antennas with protective tape.

6. Antennas are not lightning arresters

Antennas on buildings are not used as lightning arresters.

Select the position of the antenna carefully, use surge protection and do not route the antenna cable parallel to the lightning arrester.



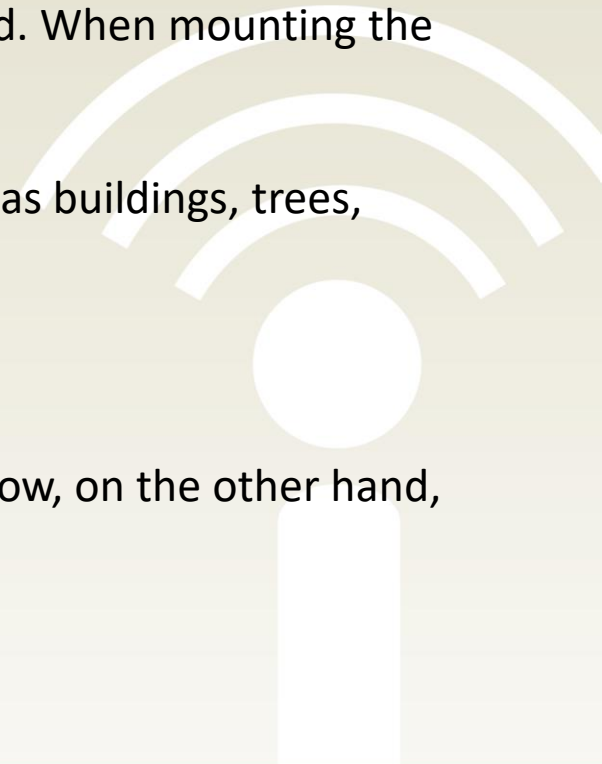
10 General antenna rules

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- **7. Correct mounting**
- In the case of insufficient stability, the quality the antenna alignment can be reduced. When mounting the antenna, also think about wind and other outside influences.
- **8. The right distance**
- Install the antenna in an open area, as far away as possible from any obstacles such as buildings, trees, other antennas or metal objects.
- **9. Connection to antenna from below**
- Outdoor antenna cables should always be connected to the antenna from below.
- **10. Weather influences**
- Fog and rain have nearly no influence on the wireless path. In the case of ice and snow, on the other hand, you must make sure that the antennas are not covered with ice.



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