PRICER

BRINGING TRUST TO RETAIL

UNDERSTANDING THE BENEFITS OF A PRICER SYSTEM

Part 2 – The Benefits of Optical Wireless (Infrared) Communications

A Guide for Pricer Partners and Resellers

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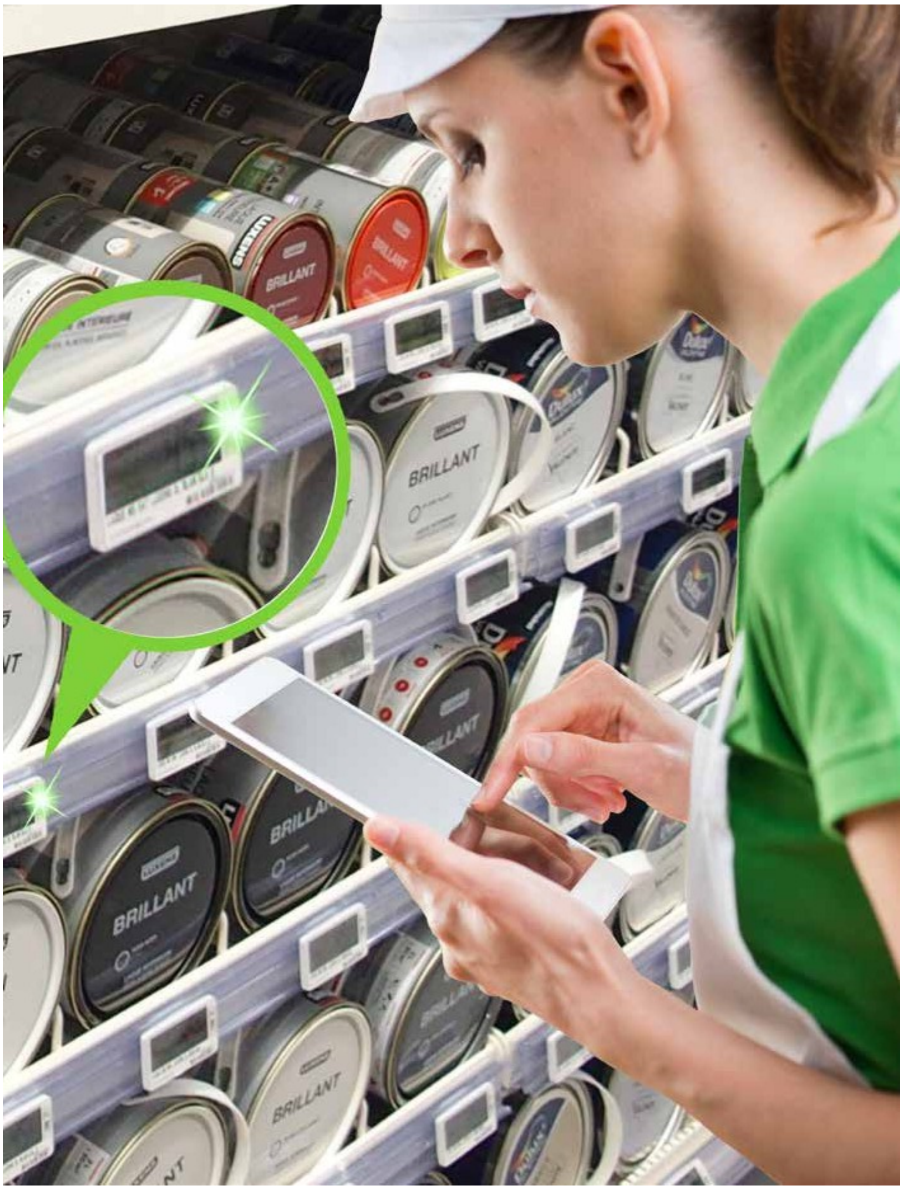
Benefits of Optical Communications

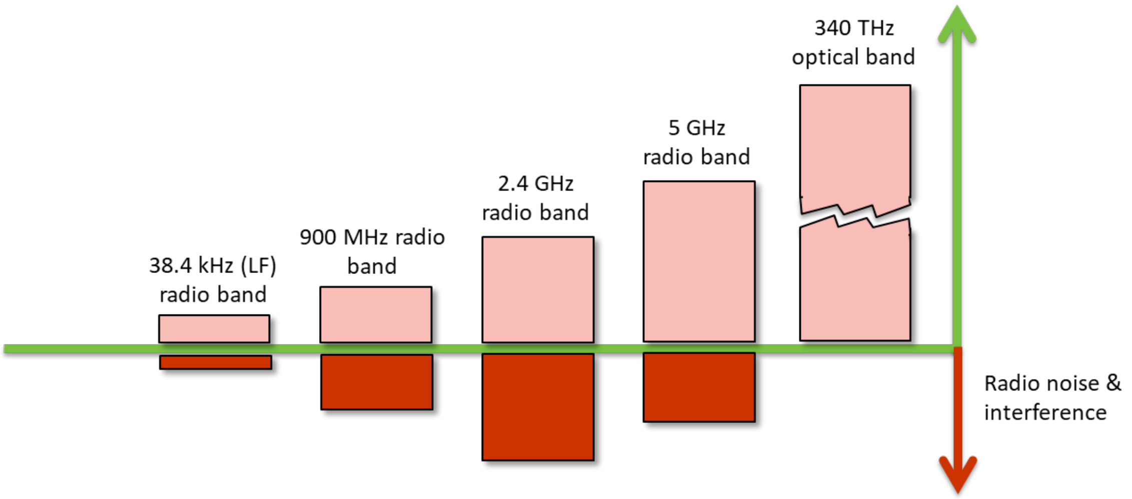


Benefits with Optical Communications

1. Introduction

A central feature of any ESL system is the communication between labels and access points. The choice of communication solution has a very significant impact upon the performance of the entire ESL system and determines the ESL system's ability to support the user needs, be it in terms of responsiveness, reliability, speed and capacity.

A customer of an ESL system today can choose between the following communications solutions:



As evident in the picture above, there are four alternative radio-based ESL solutions and one optical-based solution (from Pricer).

Pricer has extensive experience and knowledge of radio-based ESL system. Pricer has developed its own 868/915 MHz ESL system which is uses as a test bed and technology available for future deployment in certain specialised vertical markets. Pricer has a special relationship through its ownership structure with a radio-based ESL supplier that specialises in the retail fashion vertical. Furthermore, Pricer's executive team and top engineers have extensive track record from best-in-class radio companies such as Nokia, Ericsson and Cisco.

Pricer has a choice of using radio or optical communications in their systems, and this chapter will present the core reasons why Pricer has elected to continue the deployment of optical systems.

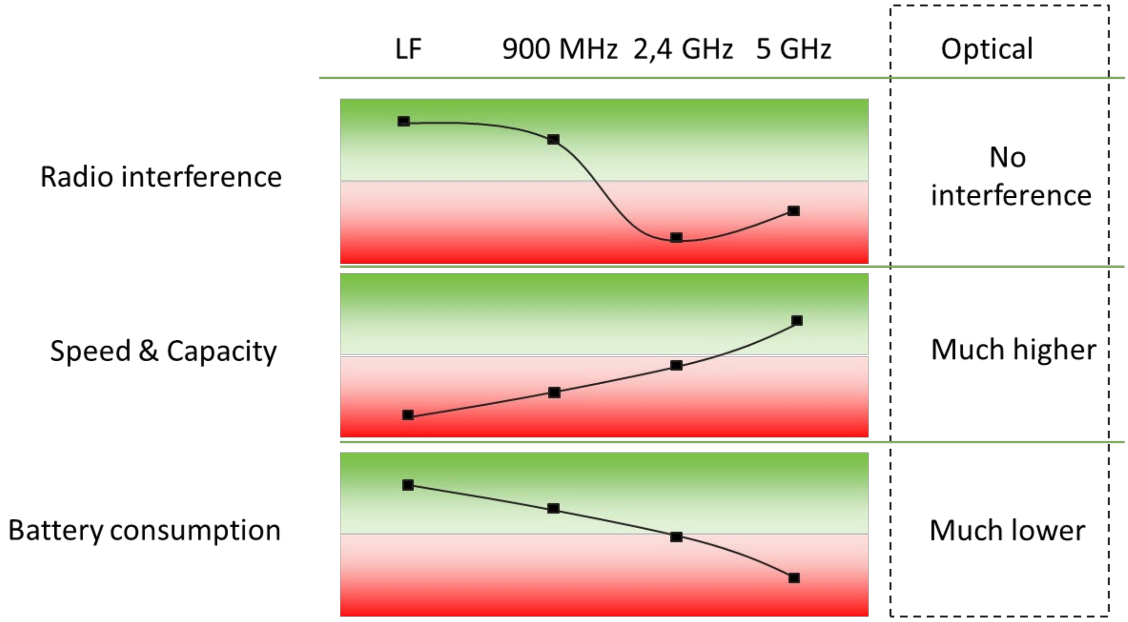
Pricer believes in deploying the best communication solution for each application and use, as follows:

- For ESL communication between labels and access points: *optical*
- For high-bandwidth non-time-critical uplink communication between shelf space surveying cameras and access points: *radio*. For downlink time-critical communications, *optical.*
- For communications between handheld terminals and access points: *radio*

Pricer recognises that radio-based ESL systems may appear to have several advantages over optical based systems: it may be initially easier to deploy using an existing (although likely highly congested) radio infrastructure; it may have advantages for outdoor applications and for the retail fashion vertical due to the nature of clothing rack type displays.

However, for deployment in food supermarkets and hypermarkets. DIY or Home Goods, pharmacies and other environments that primarily use shelves or free standing displays, optical-based communication is a superior choice.

As evident in the picture below, every choice of radio-solution represents a trade-off between problems with radio interference, speed and capacity and battery consumption.



The discussions in this chapter will focus on the 2.4 GHz radio-based solutions versus optical for the following reasons:

- The LF (low frequency) solutions are no longer considered marketable due to their very slow speed and responsiveness.
- The 900 MHz solutions are too low capacity and too slow in responsiveness to be competitive for retailers who are looking at deploying modern in-store process optimisation use cases.
- The 5GHz systems battery consumption is very high and gives a label lifetime of less than 3 years, hence making it very difficult for food retail customers to get acceptable ROI.

Pricer's focus is on delivering systems that enable their customers to 1) realise significant cost savings through in-store process optimisation and 2) increase shopper satisfaction and sales growth through shopper guidance and promotional support.

The choice of communications technology will have a significant impact on customers' ability to realise these benefits. Specifically, this choice will have an impact on the following three parameters:

- ESL system reliability
- ESL system responsiveness
- ESL system speed and capacity

Each of these aspects will be reviewed in detail in the following three chapters.

2. ESL system reliability

In many radio-based (2.4 GHz) installations that have been operational for two to three years, there is evidence of labels with dead batteries.

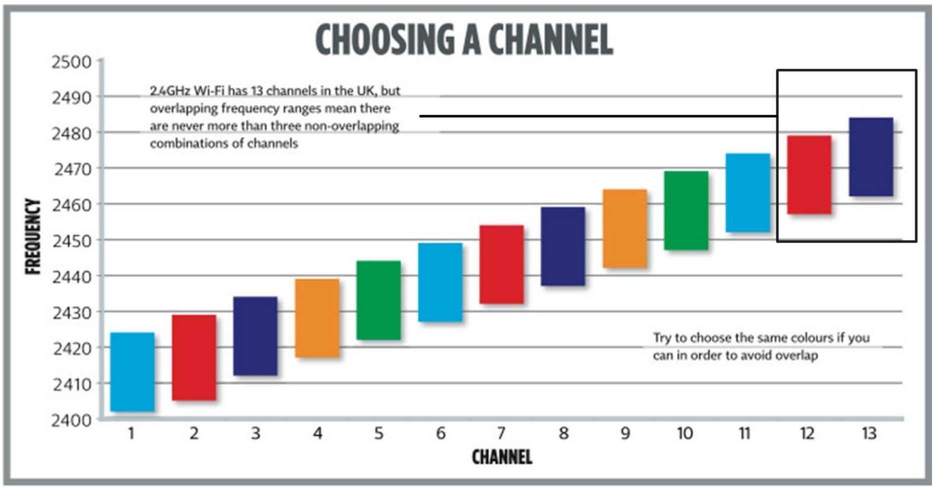
Dead (or non-communicative) labels are not always identifiable since they continue to display an old outdated price after they
have died.

But where the problem has been identified by store staff, and has been replaced by a paper label, then the problem is clear to see, as exemplified by the following photographs.

The important thing to note in these photographs is the seemingly randomness of which labels are dead, and which are still functioning. On the same store section, there can be dead labels mixed with functioning labels.

Most of these problems come from the complex issue of radio interference. The interference challenge comes from the fact that the 2.4 GHz radio-based ESL system is sharing the same radio spectrum as the 2.4 GHz Wi-Fi system.

The 2.4 GHz spectrum available is typically 0.1 GHz wide and is used by Wi-Fi in the following way/ spectrum spacing:

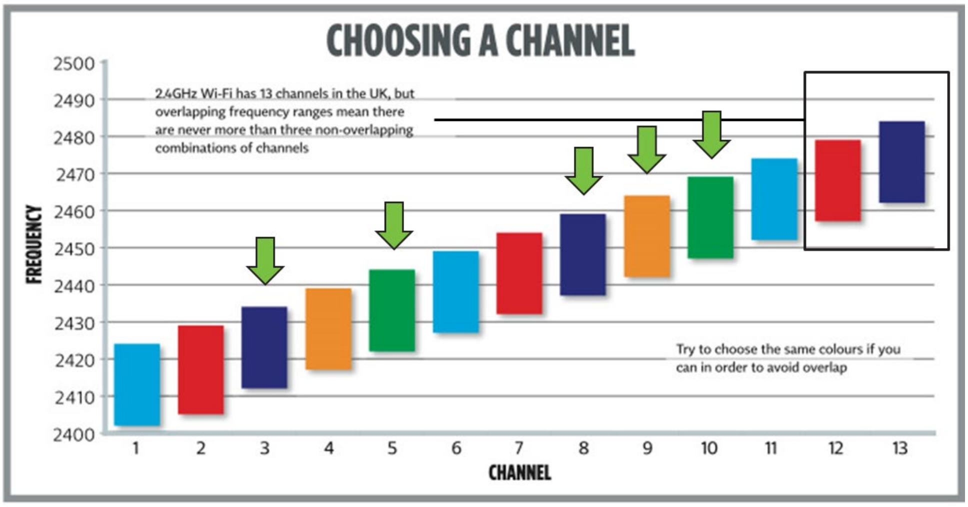


As evident in the picture above, the Wi-Fi channels are very wide, and have a lot of overlap. For this reason, most Wi-Fi users are placing all their traffic on channel 1, 6 and 11. These are the only non-overlapping channels available (except for some countries where there are two additional channels).

Most retail stores have significant amount of traffic on their Wi-Fi installation from services such as:

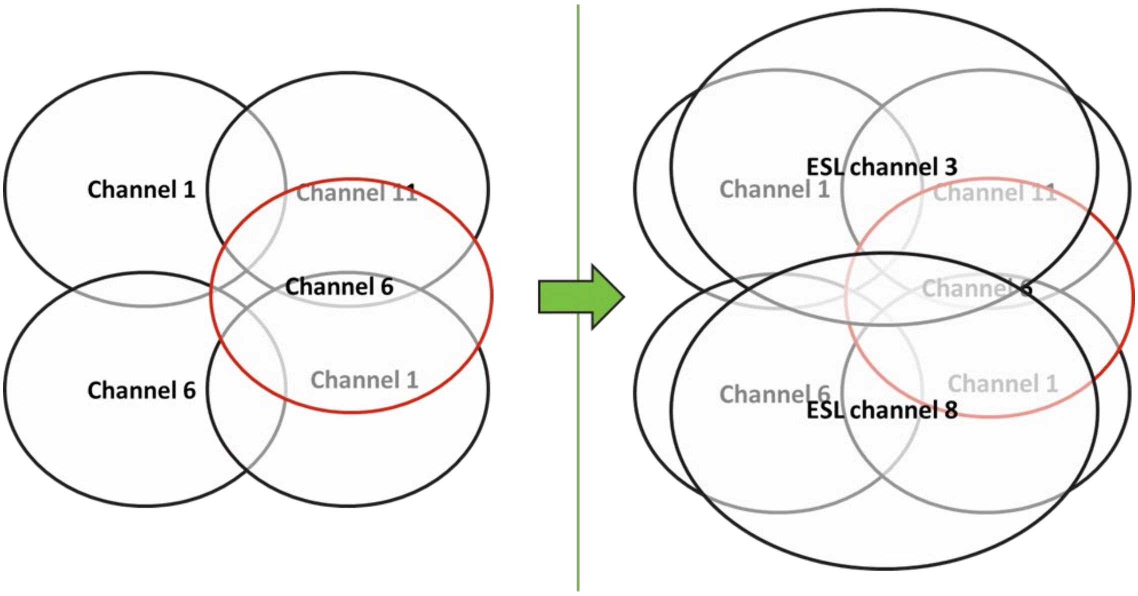
- Back office computer systems, printers, scales
- Customers' Wi-Fi access
- POS solutions
- Employee terminals for in-store operations
- Digital signage solutions
- Self-service scales
- Bluetooth devices (running on 2.4GHz)
- In-store communications (cordless phones)
- Neighbouring stores

The problem arises when the ESL system is installed on top of the Wi-Fi installation. The ESL systems are typically installed on channel 3, 5, 8, 9 and 10, and unfortunately, these channels overlap to a certain degree with the existing Wi-Fi channels:



The problem of interference is further exacerbated because the size of ESL radio cells is bigger than that of Wi-Fi radio cells.

In other words, a typical ESL radio cell will overlap several Wi-Fi cells; where each Wi-Fi cell is using a different channel. This means that a typical ESL radio cell will incur interference from several Wi-Fi channels at the same time.

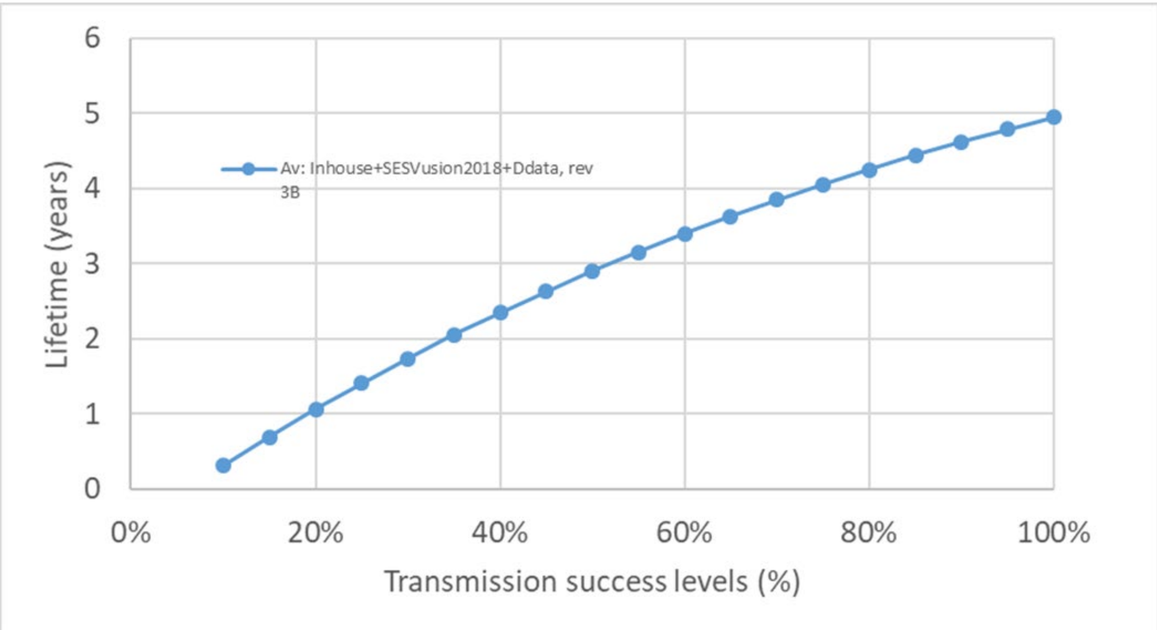


The picture above (left hand part) illustrates a typical Wi-Fi installation on channel 1, 6 and 11, where the red radio cell has been added to cover an area of weak radio coverage (for example due to high gondolas with liquids).

The ESL radio-based system is installed on top of this installation (see right hand part of picture), and because the ESL radio cells typically are larger, the complexity on the issue of interference is very high. For example, ESL channel 3 is being interfered by Wi-Fi cell 1 and 6 depending upon location. The bigger the size of the ESL radio cells, the bigger the interference problems becomes.

The higher the level of interference, the higher the number of retransmissions that the radio-based ESL label needs to do. This is consuming the limited battery capacity and thus shortening the life of the ESL label.

The standard relationship between level of radio interference and the ESL label battery life can be seen in the graph below.



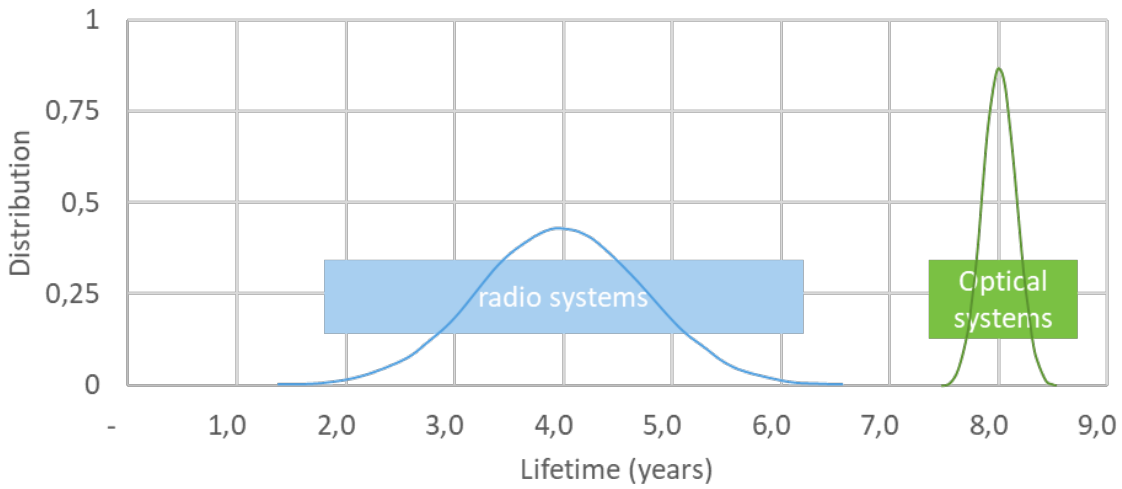
Since the level of interference vary widely within retail stores, the battery lifetime of each individual ESL radio-based label will vary.

In other words, for a radio-based ESL system:

- Every label has its own unpredictable battery life
- Every store (interference level) is different
- Every label location within the store is different
- Range of battery lifetime: 2–6 years

An optical-based ESL system has none of these problems since there is zero level interference on the 340 THz optical band.

This is the main reason for why Pricer has elected to continue with its optical-based system despite having access to the radio technology – the ability to offer a zero-interval predictable label battery life:



3. ESL system responsiveness

As has been described in the use case section in Part 1, the ESL system responsiveness (latency) is very important in order to implement important use cases such as *pick-to-light* and replenishment.

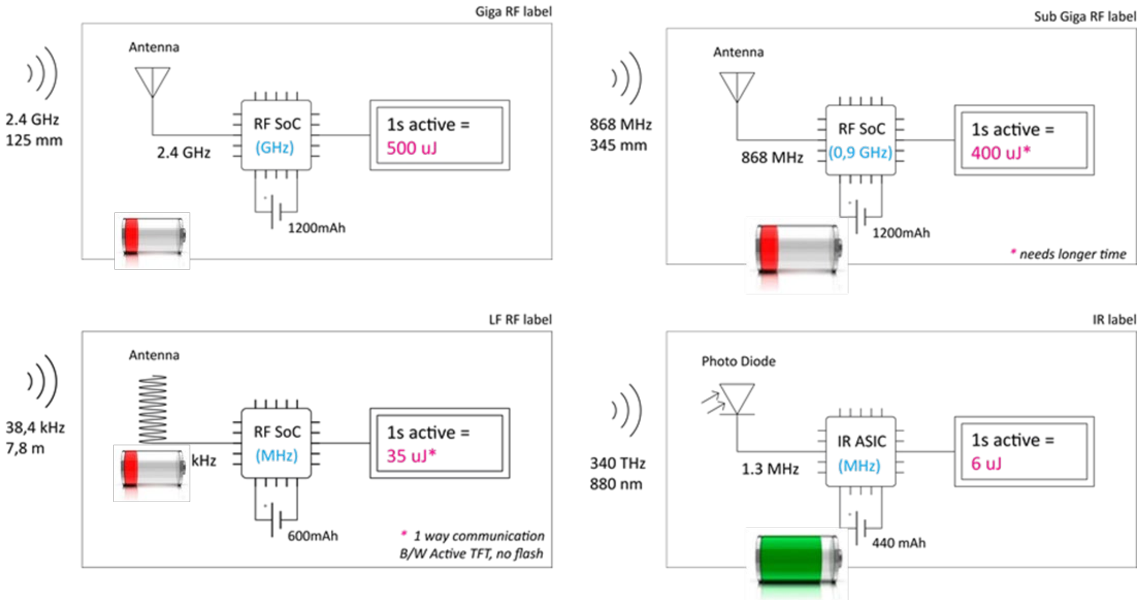
These are the industry standards on responsiveness:

- Optical-based systems: sub-1 second from command, to start of flash
- Radio-based systems:
  1. Standard: 16-24 seconds
  2. Slow: minutes
  3. Demo mode: 2-3 seconds

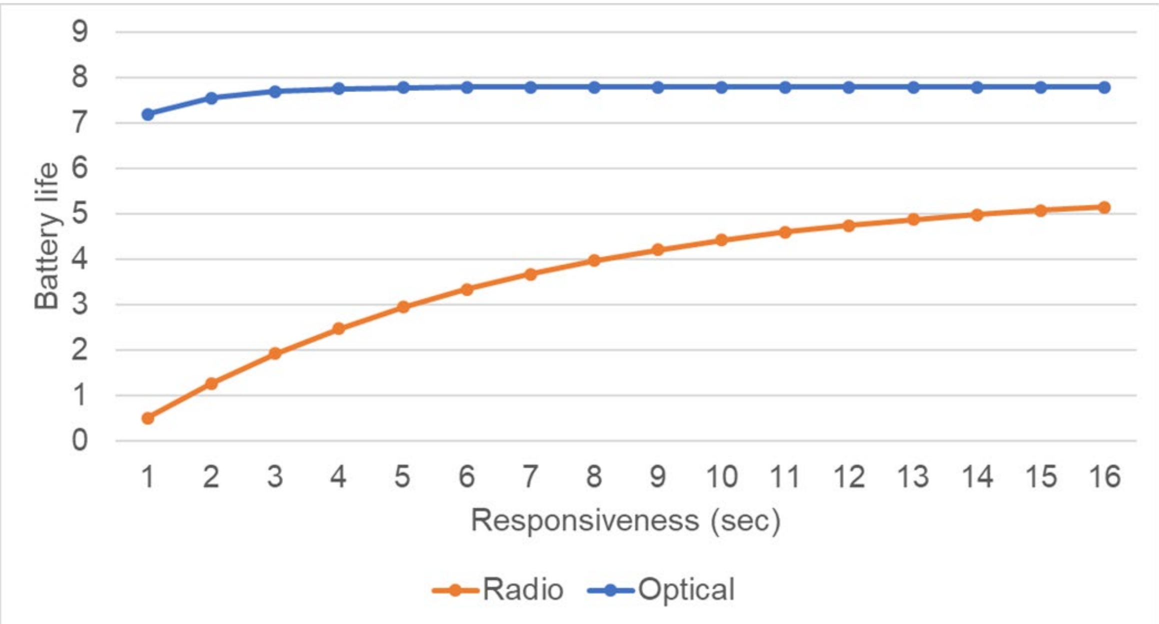
It is Pricer's belief that any responsiveness less than 1 second is unacceptable for a modern food retailer. This is the second reason for Pricer's choice of using optical communications in their system.

The reason for radio-based systems' very poor responsiveness is that 1) the higher the responsiveness, the more frequent the label needs to conduct a listening event (contact the access point) and 2) the listening events are very costly from a battery point-of-view. In other words, for a radio-based system, battery capacity is a scarce resource and needs to be rationed.

In the picture below, the battery consumption is illustrated for typical radio systems at LF, 2.4 GHz, 900 MHz and optical systems.



The battery cost of a listening event for a 2.4 GHz system is 83 times higher than an optical system (500 μJ versus 6 μJ). Because there is a limited availability of battery capacity, it leads to the following technical relationship between battery life and responsiveness:



In response to this challenging weakness, some radio-based ESL suppliers propose to use a *variable mode* in order to offer a fast responsiveness for a limited part of the day.

With a limited use of fast flash, the impact on the label battery life would look as follows:

For a 24-hour period: Number of hours with 2 second flash (remaining period with a 16 second flash)	Label battery life (years)
0	5, 0
1	3, 9
2	3, 2
3	2, 7
4	2, 3
5	2, 0

As evident in the table above, even with just 1 hour per day of a fast flash, the label battery life is reduced by more than 1 year.

This battery life reduction can be offset by adding a night sleep mode to the operating pattern. For example, by offering 1 hour of fast flash in combination with deactivating the system for 8 hours per night, the label battery life would be 5.2 years.

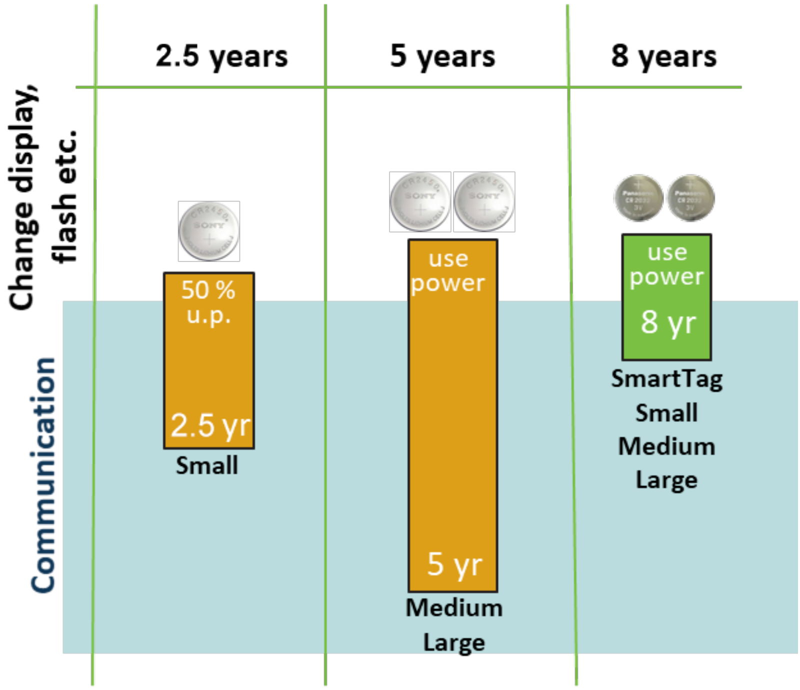
Pricer's view is that the operational compromises and trade-offs above are not suitable for modern retail operations.

4. Small labels – a special challenge

Because radio-based labels use a lot of battery power for communication with the access points (83 times more than optical), most of the labels' battery budget is consumed by communications (between label and access point) – as evident in the picture below. Because of their high battery consumption, radio-based labels need to use large CR 2450 batteries (compared to the smaller batteries using in Pricer's system).

This creates a specific problem for small labels. For the radio-based system, there simply is not sufficient physical space to carry two large batteries. Instead, they carry one large battery. This reduces the lifetime of small labels 1.6" by approximately half.

This should be of great concern to any retailer who wants to deploy a mix of small and larger labels. The small labels will have a very short battery life, even before considering the additional challenges of radio interference. Pricer believes that small radio-based labels are not fit for purpose in a modern retail environment.



This shortcoming is not *always* described *accurately by* radio-based ESL suppliers. See the table below comparing *stated battery* life compared to *estimated real battery* life (as per standard convention) for three prominent ESL suppliers:

Radio-based ESL Supplier 1				
Label size	Battery capacity	Updates per day	Battery life according to specs. (years)	Estimated real battery life (years)
Small - 1,6"	550 mAh	1	5	2,73
Medium - 2,2"	1100 mAh	2	5	5,00
Radio-based ESL Supplier 2				
Label size	Battery capacity	Updates per day	Battery life according to specs. (years)	Estimated real battery life (years)
Small - 1,6"	550 mAh	1	5	2,73
Medium - 2,2"	1100 mAh	2	5	5,00
Radio-based ESL Supplier 3				
Label size	Battery capacity	Updates per day	Battery life according to specs. (years)	Estimated real battery life (years)
Small - 1,6"	1000 mAh	4	3	3,88
Medium - 2,2"	1100 mAh	4	5	4,27

5. ESL system speed and capacity

ESl systems' speed and capacity is typically measured in terms of number of updates per hour and are broadly estimated as follows:

Communications	Segment labels	Graphic labels
Radio	23,000	8,500
Optical	90,000	38,000

Speed and capacity are tightly related to communications frequency, meaning that the higher the frequency, the higher the available bandwidth and speed. For radio-base systems, this means that the low frequency systems have the lowest speed and the 5 GHz solutions have the highest speed. None of them can match the speed of Pricer's optical system.

This aspect of ESL systems is not critical if a retailer run the system in small stores with few labels, and where labels are only updated rarely (once a week or less).

However, in modern supermarkets and hypermarkets, where updates need to be executed in limited time-windows, and where updates are frequent (either for updating of price or updating of inventory information), the speed and capacity will be a bottleneck for in-store operations if the retailer selects a radio-based system.

For examples; in a hypermarket using 70,000 labels, it would take 8.2 hours to make an inventory update with a radio-based system, as compared to 1.8 hours with Pricer's system.

6. ESL infrastructure

The infrastructure (the access points in the ceiling) for radio-based solutions may appear to be lighter than that of optical-based solutions, in the sense the fewer access points are required to cover a certain surface area. This may result in apparently lower *initial* deployment costs for radio-based systems.

However, it is very difficult to achieve perfect radio coverage when deploying in the 2.4 GHz band, since the radio penetration is highly impacted by nearby structures (shelf systems) and their contents. This inevitable results in dark spots with weak or zero radio coverage. This typically requires adjustments, re-installations or moving of access points which are done post-installation and tend to be disruptive and costly. If these dark spots are not detected, they will result in certain labels dying early or never being updated.

The optical infrastructure is very stable and predictable. It is an install-and-forget solution with extremely high reliability.

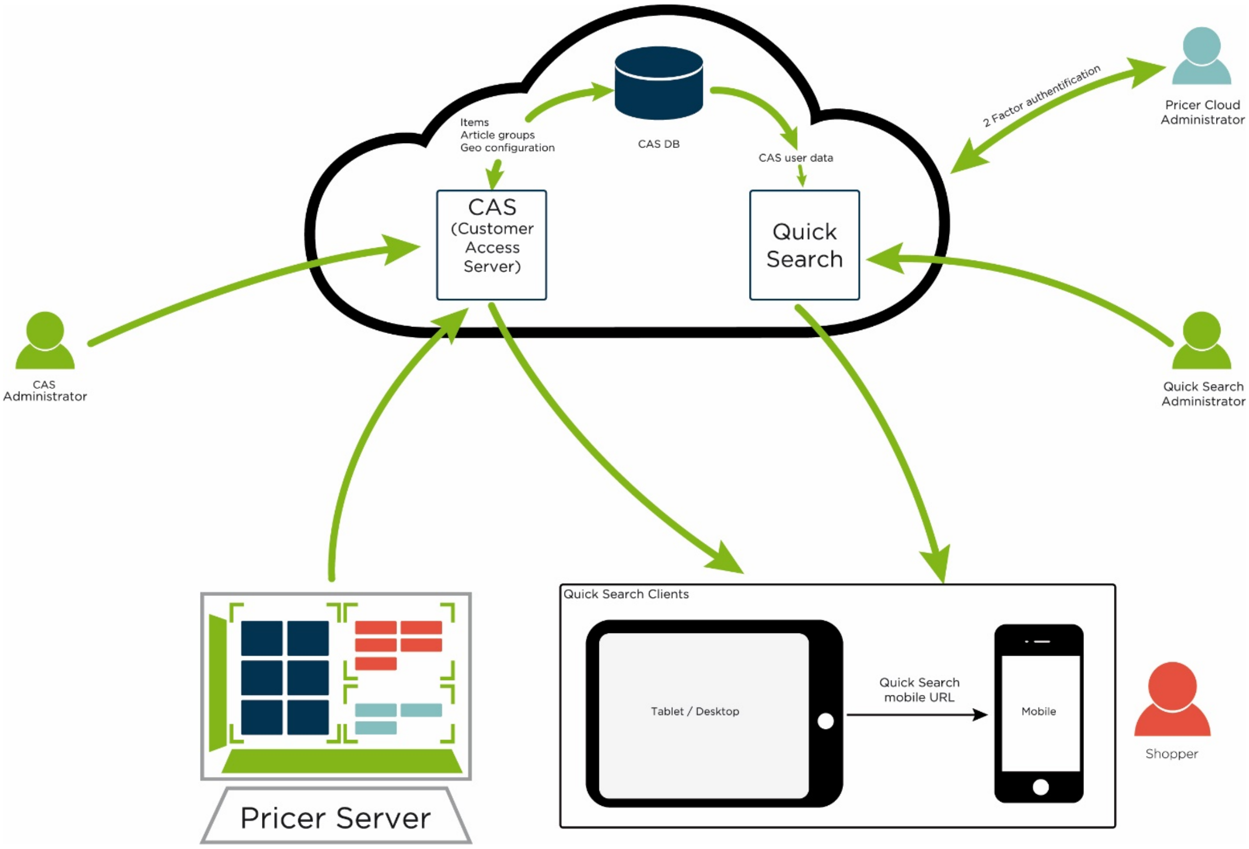
A more strategic benefit with the optical infrastructure is its ability to do geo-positioning of individual labels through trilateration (a mathematical technique to determine label position by receiving and analysing optical signals from multiple access points). By systematically applying this technique, Pricer's system can determine the geo-location of each label in the system on an on-going basis, which means that it automatically updates positions and the layout of a store changes.

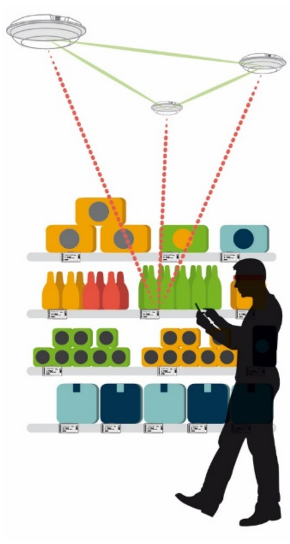
This technique is not available for radio-based systems due to the scatter effect of 2.4 GHz radio in confined spaces. In other words, retailers who wants to incorporate geo-positioning and mapping capabilities in their use cases, AND who wants the geo-positioning data to be automatically updated as and when the store layout changes, need to choose an optical-based system.

In-store positioning

Automated in-store product positioning has remained the “holy grail”. As retailers digitally transform their businesses, several technologies are forming the new fabric of store infrastructure, enabling real-time interactions with products, people, and processes.

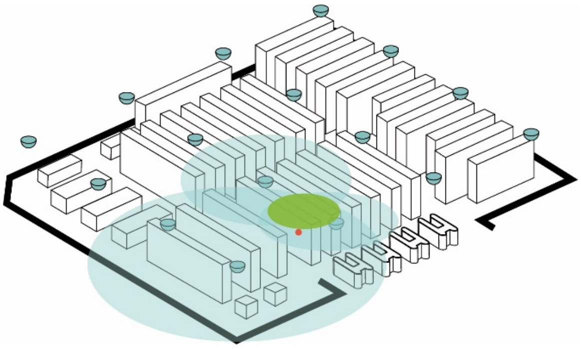
Optical Wireless (infrared) technology is playing an important role, bringing product positioning to life in brick-and-mortar retail. The instrumentation of the shelf and intelligent application of product positioning open up significant opportunity for more efficient retail execution in the store as well as better customer service for omni-channel retail on the sales floor.

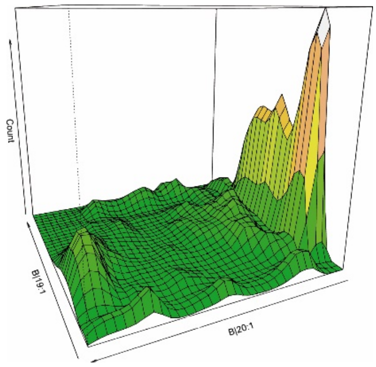




A fast and energy-saving technology, infrared (IR) communication accomplishes this task in conjunction with algorithms that calculate the position of products using trilateration.

IR technology can literally map where products have been placed on the sales floor, which can help engage customers in-aisle, help customers find products in-store, and manage product placement compliance.



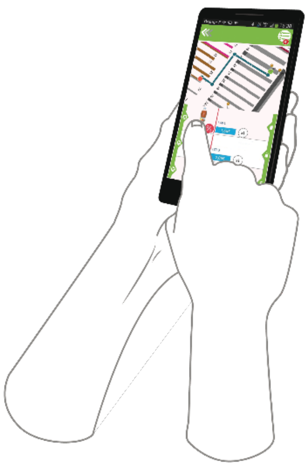


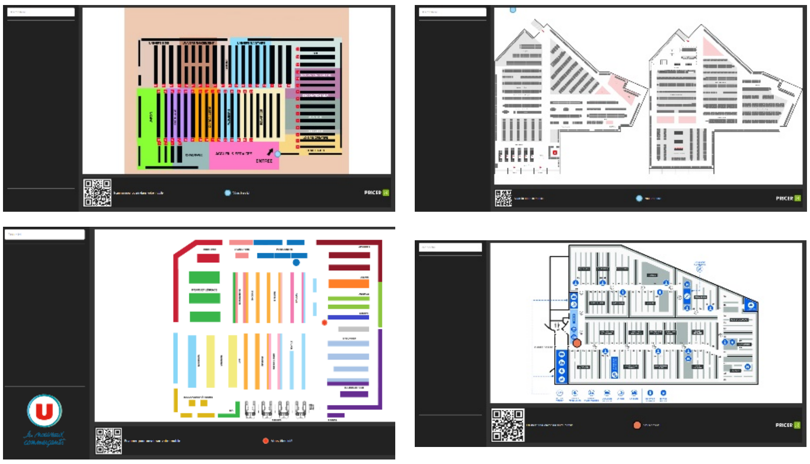
What is IR geo-positioning – how does it work?

- A typical Pricer label response signal is seen by multiple points in the communication network reading different signal strengths depending on the distance from the label: that is trilateration.
- All labels are automatically positioned either on-demand or scheduled.
- Work with individual products or categories.

In-store maps

With product geo-positioning, it is critical to have appealing and accurate maps. Pricer provides the tools to create, update and distribute maps for multi-store retailers. Automatic cloud distribution to mobile apps. SDK for IOS and Android.





In-store consumer guidance - the Pricer search

The Kiosk provides shoppers with product location based on Pricer's ability to automatically geo-locate the product's Electronic Shelf Label in the store.

The shopper can search products directly on the interactive terminal or transfer the link of the digital store map to a smartphone without opening a specific application.

Pricer Search supports all Pricer Electronic Shelf Labels generations.

Customer and store benefits :

- The shopper becomes more autonomous to find products and promotions
- Automatic item location in the store through the Pricer Search or a smartphone supported by shopper application integration or direct URL link
- Associates can guide with precision customer requests by showing a PDA screen
- Enriching the customer experience and improved customer loyalty
- Ability to enforce and audit the planogram compliance

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365 by Whole Foods Market	A2 pas	ALIMERKA Supermercados	Auchan	axfood
belgacom	Best Buy	BMR	Brico Center	Brico Marché
BYKO	Carrefour	Carrefour market	Groupe Casino Nourrir un monde de diversité	castorama
CEPSA	Chedraui cuesta menos	coop	cora	jeca
Delhaize	E.Leclerc	Euronics	Fillion Électronique	franprix
Nebraska Furniture Mart	Supermarchés G20	Géant Casino	Grand Frais	ICA
いなげや	KESKO	laComer	Leader Price	Leroy Merlin
les Mousquetaires	MEDIA-SATURN	metro Food at its best.	MOBO Original Accessories	NorgesGruppen
orange	PM Patrick Morin des gens constructifs	Pick n Pay	PIXMANIA	PLUS
REMA 1000	RONA doing it right	Shufu no mise	Soriana	SPAR
Système U	Unimat	verizon	VIVA	Whole Foods Market

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Version 1.0, 2020