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Recommendation for inclusion of Wireless light switches in the KP standards

Summary of Recommendation

Kaiser Permanente (KP) should require its design and construction teams to use wireless light switches as the basis of system, with an add alternate for using conventional switches. Within the constraint of P&S, we recommend that KP negotiate a pricing agreement with one or more manufacturers in order to obtain pricing that will ensure financial viability.

Abstract

Wireless light switches have been installed and operated in European buildings for years; they have been available in the United States for at least five years. While they are not yet widely used in U.S. hospitals, there are a handful of manufacturers whose products could and would work well in hospital settings.

Wireless light switches offer significant advantages over conventional switches:

- Lower Cost
  - The devices cost somewhat more than conventional devices, but they eliminate the need for backboxes, conduit, and wiring. The elimination of these costs offsets the added cost of the wireless devices so that they are at least cost neutral in most cases.
- Green
  - They use far fewer materials than conventional methods; less need for consumption of natural resources.
  - They eliminate the need for the PVC that is used to make the wire that they replace.
  - Because they use less materials, there is less end of life disposal burden.
  - They contain no batteries, so that there is no need for later disposal of toxics.
  - They use virtually no energy.
- They are safe
  - They operate on a weak radio signal and on a frequency that will never interfere with medical devices; it is the frequency used by garage door openers.
  - It has been demonstrated by Kaiser and other hospitals to be safe.

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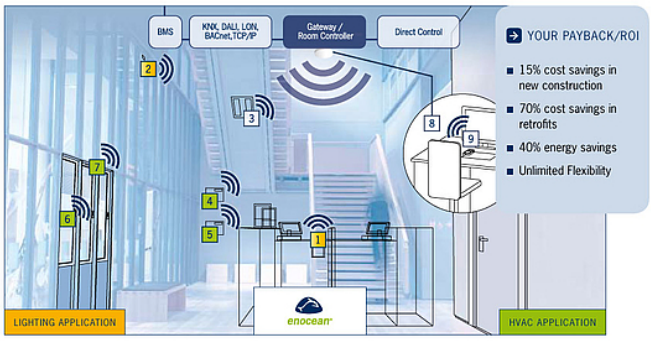
1. Wireless Light Switches



Wireless switches use the same technology as other wireless devices and operate by sending radio signals, rather than by interrupting the flow of power to a fixture through electrical wiring. This eliminates the need to run wire through walls and ceilings from switches to fixtures. Preliminary cost studies done by Jeff Rodriguez, former KP electrician, show that the technology is approximately cost-neutral for new construction, but saves substantially over traditional systems when it comes to retrofits, due to a savings in labor costs. We believe that, if the switches were purchased in volume, or if KP were able to negotiate some sort of national purchasing agreement, KP could reduce its cost for the switches to ensure economic viability in ALL cases.

Many manufacturers have adopted wireless light switching technology and their products are widely available on the market. These include products made by *Illumra*, *Leviton* and *Lutron*. For the purposes of the Kaiser San Francisco study, *Illumra* self-powered light switching products using *EnOcean* wireless switching technology were installed and tested.

1.1 The technology

Illumra: These self-powered light switches use an innovative *EnOcean* technology that converts the press of a switch into a small amount of electricity. The receiver is hardwired in line with the light fixture. *Illumra's* wireless solution is battery-free, giving it a big advantage over other, similar products, and also reducing maintenance costs since batteries do not have to be changed.

Leviton: Some of *Leviton's* wireless light switching systems use batteries, others have been introduced that also use *EnOcean's* technology to charge the switch each time the button is pressed, replacing the need for batteries.

Lutron: *Lutron's* Maestro wireless technology uses long-life batteries to power switches and receivers. *Lutron's* wireless control and sensors allow you to control lighting levels with any combination of up to 10 dimmers, switches, sensors and wireless controls.

1.2 Uses of wireless light switches

Battery-free wireless light switches have been used primarily to light homes and businesses, but they can be used to control virtually any on/off device, including appliances. The technology allows them to be paired with occupancy sensors and dimmers in the same way that traditional, wired lighting is; providing the same functionality with much greater flexibility.

2. KP Testing

2.1 KPIT Safety Testing

KP's wireless lab tested the units in fall, 2008, at the behest of the KP High Performance Building Committee. The results, as reported by Rob Hutchinson, were that the switches did not interfere with any medical devices, and were not forseen to be present any safety hazards to KP or its patients.

2.2 In situ testing

KP electricians installed four *Illumra* wireless switch and receiver combinations in Kaiser Hospital San Francisco to conduct a controlled test of the technology's use in a healthcare environment. The locations throughout the hospital were chosen for convenience of location and the ability to control the environment.

In all installations, the following *Illumra* units were installed, all of which controlled the lighting in the four locations:

#E3T-S1AIV Switch
#E3R-R27-5IBTP Receivers (277V)
#E3R-R12-5IBTP (120V)

Location	Room Type	Number of Lights	Installation Duration
2425 Geary Lobby	Admin Restroom	1	2 years
2425 Geary 1st Flr	Mechanical Room	3	1 year 6 months
2425 Geary Mezzanine	Telecom Room	2	1 year 6 months
2425 Geary 3rd Floor	Patient Room	2	1 year 6 months

3. Potential concerns about use of wireless light switches

3.1 Potential for interference

One of the recently-cited concerns with the use of these devices in health care settings is that the signals created may interfere with medical device signals. The frequency used by wireless light switches is similar to the low-frequencies used by garage door openers, a frequency not used in

health care settings. In addition, independent testing by KPIT found that the EnOcean wireless switching frequencies posed no interference with medical devices.

KPIT's testers recommended against deploying the wireless switches, arguing that, though they were not currently using this frequency, at some point, they might need it. The low-level radio frequency used by wireless light switches is similar to those used by residential and commercial garage door openers. It is highly unlikely that Kaiser Permanente—or other hospitals—will begin deploying medical or other devices that use this frequency in the near or long-term.

Finally, as proof of concept, Kaiser Permanente installed several wireless switches at Kaiser San Francisco Medical Center several years ago and these have operated without incident or interference.

3.2 Parasitic energy consumption

Most switching devices only use energy that is generated by the switch itself. However, the receiving units do consume energy. Published literature indicates that the units use a small amount of energy on a continuous basis. Multiplied by 24 hours a day, 7 days a week, 365 days a year, over every switch in a building, this would represent a huge amount of added energy cost to Kaiser Permanente—if these usage figures were correct.

The truth is that this is the maximum amount of energy that these devices use. But, the use is momentary, not ongoing. In fact, for the vast majority of the time, the device uses no energy at all, since it is not being switched on or off. To test this issue, M+NLB hired Power Analytical to perform energy consumption monitoring on switches installed at its San Francisco hospital. The objective was to test the devices in real-world health care conditions. These switches are located in several frequently used spaces in the hospital, and, so represent an appropriate test for the equipment.

Power Analytical found that the units consumed a total of 0 watts over seven days, despite multiple switch operations. Parasitic energy consumption is not a concern.

EnOcean-Illumra
File C:\PowerSight\enocean.log
Test began at 6/01/10 19:26:36
Test ended at 6/02/10 8:18:16

Measurement	Value	Units
Current, Phase 1, Ave:	0.0	amps
Current, Phase 1, Max:	0.0	amps
Current, Phase 1, Min:	0.0	amps
Current, Phase 2, Ave:	0.2	amps
Current, Phase 2, Max:	0.2	amps
Current, Phase 2, Min:	0.2	amps

4.0. Cost evaluation

The cost evaluation data for this study are based on OSHPD and non-OSHPD requirements for installation. Each installation took into account standard materials for typical installations. These materials include twenty feet of MC, HFC, or half-inch conduit, a metal back-box for fixture/electrical feed terminations (new installation), fittings to connect MC, HFC and conduit to box system, and a single pole switch with trim.

In 2009, M+NLB evaluated the potential cost of using Leviton wireless light switches for the San Leandro project. That analysis, summarized below, shows that, for a new installation, the wireless switches are less expensive than an installation using conduit and wire, but more expensive than an installation using flexible cable for the switch leg. However, the wireless solution is the least expensive option in all cases for renovations.

Moreover, it is probable that the cost of wireless switching systems will come down as the technology is used more often. In addition, it may be true that wireless light switching systems make sense from a cost perspective in some locations but not others.

In addition, purchasing these systems in bulk for entire facilities or multiple facilities would likely bring the costs down and produce savings. If Kaiser Permanente were to enter into a national purchasing discussion with a wireless light switch system manufacturer, it is possible that lower, bulk pricing could be obtained.

Finally, we recommend that Kaiser Permanente ask for bids on wireless light switching systems on projects in order to compare them to conventional switching. These bids should allow for analysis of the cost of boxes, conduit, wiring and labor, so that cost-reducing decisions could be made for each particular project.

The following differences determine installation methods:

OSHPD

1. Metal grounded back-box mounted to studs in wall.
2. HFC cable w/ extra grounding conductor ($.90 per ft.).
3. When electrical circuit source is considered “Life Safety”, the assembly is required to be installed using a conduit/wire/box system ($.50 per ft.).

Non-OSHPD

1. Metal grounded back-box mounted to studs in wall or “cut-in” style box for retrofit installation.
2. Standard MC cable ($.40 per ft.).

New Installations

Open stud framing for rough-in w/accessible ceilings.

Illumra		
Switch / Receiver Assembly (No back-box required)		$150.00
Labor – 1 Hr.		$90.00
	Total	***$240.00***
Standard Light Switch Non-OSHPD		
Materials (MC, SP switch, Misc. elect.)		$25.00
Labor 2 Hrs.		$180.00
	Total	***$205.00***
Standard Light Switch OSHPD		
Materials (HFC, SP switch, misc. elect.)		$35.00
Labor 2 Hrs.		$180.00
	Total	***$215.00***
Standard Light Switch OSHPD (conduit/wire)		
Materials (conduit, wire, SP switch, misc. elect)		$23.00
Labor 3 Hrs.		$270.00
	Total	***$293.00***

Retrofit Installation or Relocation of Switches

Non- OSHPD installation using "cut-in" type wall boxes. OSHPD installations access to existing wall studs to mount back-boxes would be required. Both installations based on sheetrock walls and "drop-in" tile ceilings. Time included to "de-energize" circuits to accomplish "safe" connections.

Illumra		
Switch / Receiver Assembly (No back-box required)		$150.00
Labor – 1.5 Hr.		$135.00
	Total	***$285.00***
**Relocation of Illumra switch that does not require changes to "receiver" would be figured at 1 Hr. labor.*		
Standard Light Switch Non-OSHPD		
Materials (MC, SP switch, misc. elect)		$21.00
Labor 3.5 Hrs.		$315.00
	Total	***$336.00***
Standard Light Switch OSHPD		
Materials (HFC, SP switch, misc. elect.)		$33.00
Labor 3.5 Hrs.		$315.00
*Carpenter, Taper, Painter (open & close sheetrock wall)		$300.00
	Total	***$648.00***
Standard Light Switch OSHPD		

Materials (Conduit/wire, SP switch, misc. elect.)	$23.00
Labor 4.5 Hrs.	$405.00
*Carpenter, Taper, Painter (open & close sheetrock wall)	$300.00
	Total ***$728.00***

**Note: It would be necessary to open existing sheetrock walls to install electrical back-box to stud and support conductor raceways.*