



*Drivers, Challenges and Economics
for
Asset Location in Hospitals*

Frank J. Lasky

Director of Sales
InnerWireless Inc.

(703) 430-4116

Mobile (571) 277-0458

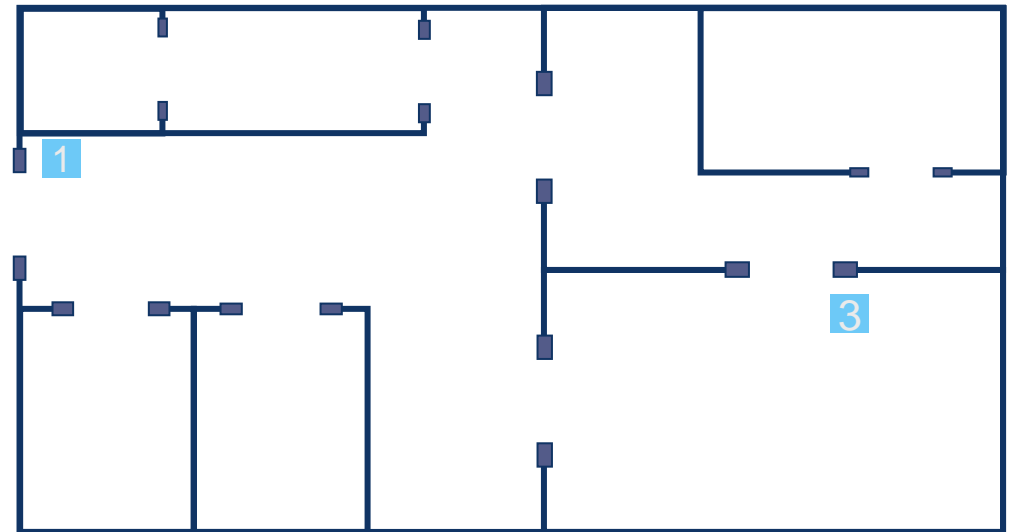
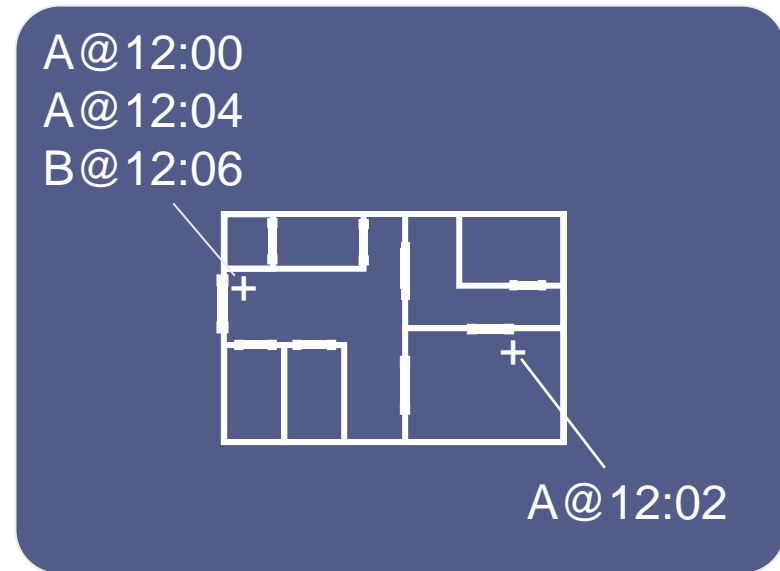
lasky@innerwireless.com

Agenda

- RFLS vs. RFID
- Drivers/issues
- Asset location system challenges
- Design choices
- Economic benefits

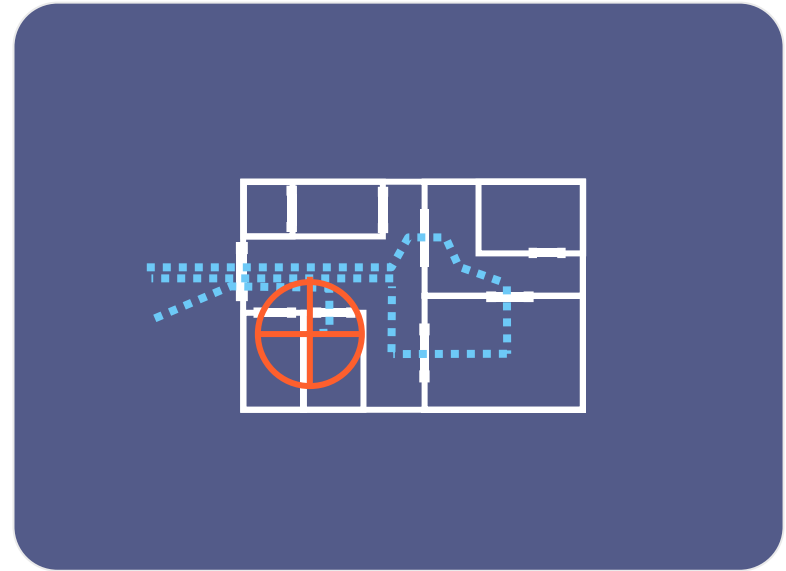
What is RFID?

- Short range readers detect and identify objects in proximity to reader
- Applications:
 - Warehouse
 - Assembly line
 - Security
 - Process validation (e.g., meds admin) A
- Readers: expensive, require network/power wiring B



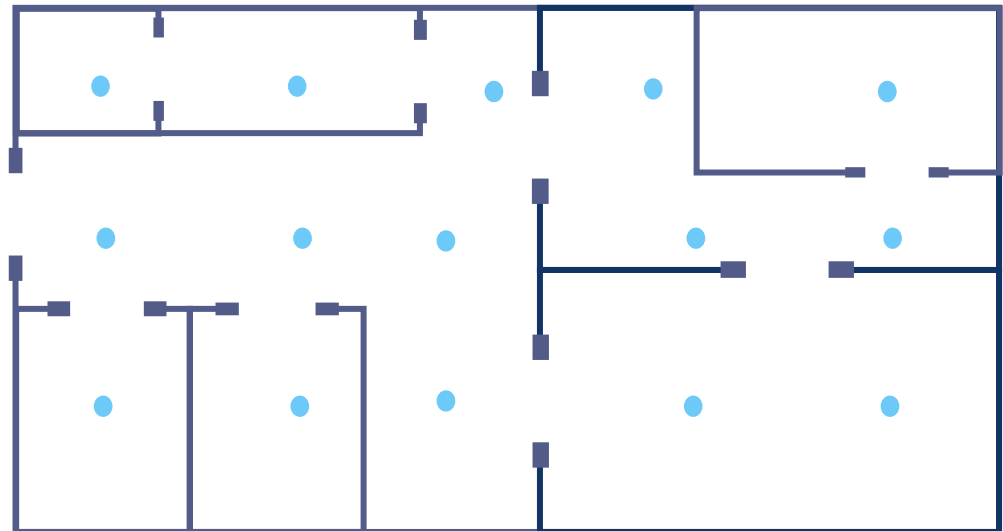
What is RFLS (RF Location System)?

- Using an array of sensors, object location in a large area is computed continually
- Where has A been?
- Where is B **now**?
- Accurate location of assets, people on demand
 - High value for healthcare



A

B



Why RFLS for Healthcare?

- Healthcare is asking for an economical, scalable healthcare-oriented foundation for
 - Asset tracking/management
 - Workflow analysis/optimization
 - Staff location
 - Patient location



Symptoms of asset management problems



What are the drivers for asset location?

- Reduction in equipment costs
 - \$4000-\$5000 per bed per year in "shrinkage."
 - Hospitals overbuy equipment by 50%
- Improved productivity
 - 30 minutes/employee/shift looking for lost equipment.
 - Up to 40% of biomed time searching for equipment
- Improved equipment utilization
 - Estimated national equipment utilization only 45%
- Improve patient throughput – increase revenue
- Help recover lost charges
 - Only 50% of infusion pumps in use are actually charged for
- Improved safety
 - JCAHO: "Equipment moving from patient to patient without decontamination has become a significant issue in infection control"
 - Maintainers cannot find equipment an estimated 20% of the time



Outlook

Over the next 18 months, we anticipate 45% of healthcare organizations (HCOs) will deploy these solutions representing a growth rate of 350%.

With asset tracking solutions, HCOs can increase equipment availability and utilization, reduce time to find equipment and decrease equipment leasing and purchasing.

- *Spyglass*

What are the design challenges?

- Accuracy and assurance
 - The hype: “locate within a few inches”
 - Economic trade-off between accuracy (e.g., 1 meter) and assurance (70% of the time)
 - The actual need in hospitals:
 - Room-level location
 - High confidence that the asset is in the indicated space

Requirement: Location in rooms/room-sized spaces with 90%+ assurance

What are the design challenges? *(continued)*

- Beacon density
 - Regardless of technology, increased quality requires more information provided to the locating algorithm
 - More information = more beacons
 - Example: GPS

Requirement: High beacon density to meet accuracy/assurance criteria

What are the design challenges? *(continued)*

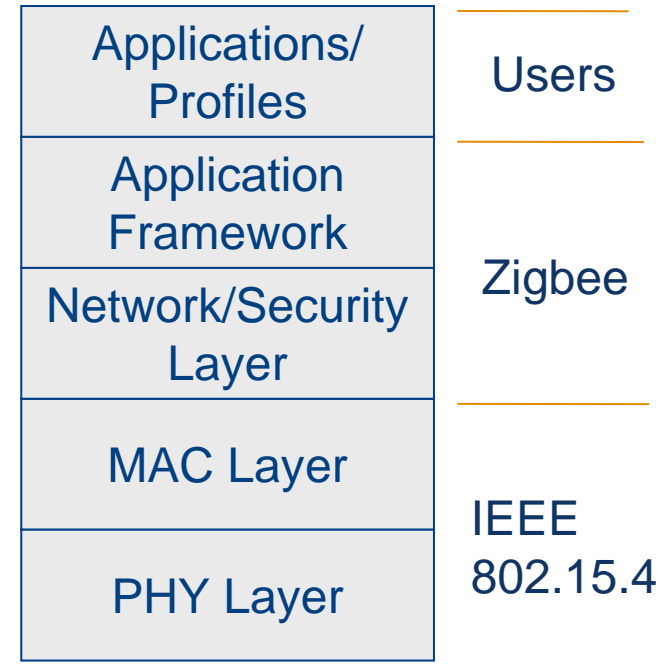
- Capital and operating costs
 - High beacon density at low cost: easy, non-disruptive installation (“cordless”), long battery life
 - Tags: low cost, small size, long battery life
- Radio technology
 - Standards-based
 - Low power consumption
 - Relatively low data rate requirements; moderately frequent transmissions.
 - Relatively simple electronics and RF requirements
 - Scalable
 - Relatively un-crowded frequency band

What are the design challenges? *(continued)*

- Usability
 - Intuitive tool for staff on-demand locating
 - Integration with other hospital Information Systems

Design choices for RFLS

- Radio technology
 - Largely determines cost, performance, battery life, scalability and device size
 - IEEE 802.15.4 (lower layers for Zigbee)
 - Designed for large numbers of devices, low data rates, very low power
 - Highly integrated single-chip implementations
 - Minimum memory
 - Lightweight software
 - Separate spectrum – not 802.11



- Protocol
 - Long "sleep" periods of very low battery drain
 - Eliminate "collisions" / acknowledgements / retries

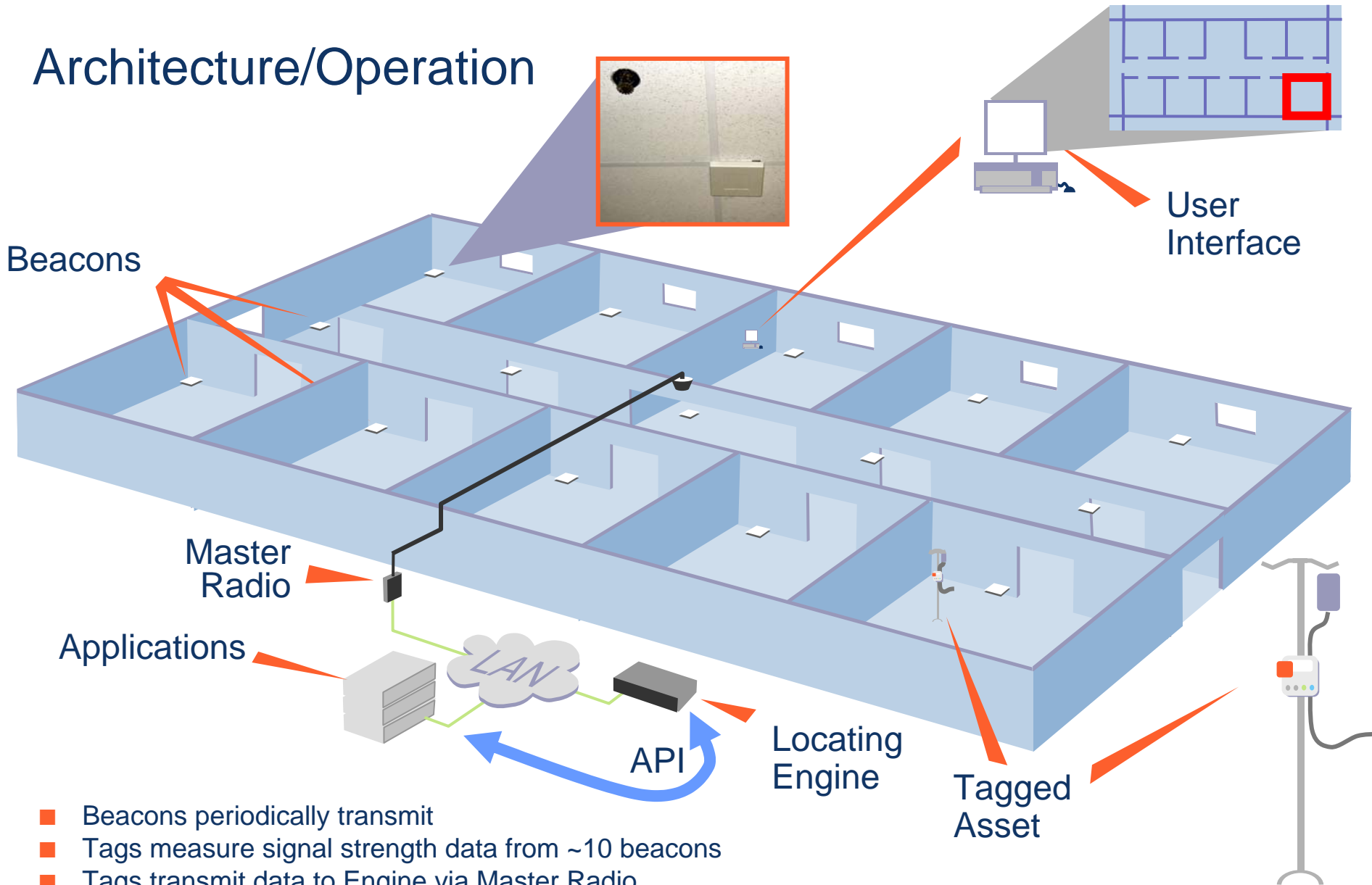
No impact on existing WiFi infrastructure, applications

- ✓ No additional traffic, congestion
- ✓ No new WiFi infrastructure

Design choices for RFLS *(continued)*

- Location algorithm
 - Take advantage of high beacon density
 - Based on in-building wireless experience and expertise
- Usage
 - Intuitive web-based GUI for staff
 - Full API for HIS integration
- Packaging
 - Tags – small, hospital-friendly
 - Beacons – no wiring, installed by hospital personnel (5 minutes training, 5 minute install)

Architecture/Operation



- Beacons periodically transmit
- Tags measure signal strength data from ~10 beacons
- Tags transmit data to Engine via Master Radio
- Engine computes location
- Staff accesses location on demand from user interface
- Other applications access location via API

RFLS summary of requirements

- Clean-sheet design for healthcare
- Room-level accuracy
- High location assurance (high confidence that tag really is where reported)
- Low cost of entry and low total cost of ownership
- Complements existing healthcare IT systems

Value of investment model

$$\text{Value Factors} + \text{Improvement Estimates} - \text{RFLS Expense} = \text{Value of Investment}$$

Equipment

- ✓ Losses (shrinkage)
- ✓ Rental costs
- ✓ Over-purchase costs

Patient throughput

- ✓ Emergency department
- ✓ Operating rooms

Productivity

- ✓ Nursing
- ✓ Biomed

Sample hospital

- “143-bed hospital facility offering high-tech medical care in a community hospital setting”
- Hospital staff provided:
 - Current operating data
 - Expected improvements from RFLS

Equipment losses

Equipment Type	Cost Each	# Lost/Year	Replacement Costs
Telemetry Equipment	\$2,500	18	\$45,000
IV Pumps	\$5,000	20	\$100,000
Wheelchairs	\$500	33	\$16,500
Mobile Beds	\$1,250	1	\$1,250
Tablet PCs	\$3,500	2	\$7,000
COWs	\$4,250	1	\$4,250
CRASH Carts	\$8,500	3	\$25,500
Annual Total Cost			\$199,500
<i>Improvement Estimate</i>		<i>50%</i>	<i>\$99,750</i>

Equipment Rental Costs

Equipment Type	Cost/ Day	Unit Days/ Year	Rental Costs
Telemetry Equipment	\$60	5,000	\$300,000
IV Pumps	\$100	5,000	\$500,000
Wheel Chairs	\$30	1,000	\$30,000
Annual Total Cost			\$830,000
<i>Improvement Estimate</i>		<i>20%</i>	<i>\$664,000</i>
<i>Annual Savings</i>			<i>\$166,000</i>

Equipment Over-purchase

Equipment Type	Over-purchased Units	Per Unit	Total Over-purchase	Reduction Estimate	
Telemetry Equipment	40	\$2,500	\$100,000	50%	\$50,000
IV Pumps	40	\$5,000	\$200,000	50%	\$100,000
Wheelchairs	80	\$500	\$40,000	50%	\$20,000
Mobile Beds	10	\$1,250	\$12,500	50%	\$6,250
Tablet PCs	35	\$3,500	\$122,500	15%	\$104,125
COWs	25	\$4,250	\$106,250	40%	\$63,750
CRASH Carts	15	\$8,500	\$127,500	30%	\$89,250
Total Cost (5 years)			\$708,750		\$433,375
Improvement (5 years)					\$275,375
<i>Annual Improvement</i>					<i>\$55,075</i>

Equipment Summary

Summary of Annual Equipment Cost Improvements	
Reduction in Equipment Losses	\$99,750
Reduction in Rental Costs	\$166,000
Reduction in Equipment Overpurchase	\$55,075
Total	\$320,825

Patient Throughput *(Patient tracking)*

	Emergency Dept		Operating Rooms	
	Current	Improvement Estimate	Current	Improvement Estimate
Annual Patients	105,500		15,000	
Average % Capacity	80%		50%	50%
Avg. Patient Stay (min.)	180	20%	144	60
Additional Annual Capacity (Hrs.)			63,300	750
% Capacity to Additional Patients			47%	45%
Additional Patients			12,396	355
Avg. Margin/Patient			\$118	\$733
<i>Additional Revenue</i>			<i>\$1,468,750</i>	<i>\$260,526</i>

Productivity - Nursing

	Current	Improvement Estimate	
Number of Nursing Staff	175		
Avg. Shifts/ Staff/ Year	365		
Minutes/ Shift Searching for Equipment	30	66%	10
Total Annual Hours Searching	31,938		10,859
Avg. Annual Overtime Hours/ Staff	50		34
Overtime Rate			\$75.00
% of Time Saved Applied to Overtime			13%
Annual Overtime Costs	\$656,250		\$446,250
Annual Savings			\$210,000

Productivity - Biomed

	Current	Improvement Estimate	
Number of Biomed Staff	10		
Minutes/ Shift Searching for Equipment	240	75%	60
Avg. Shifts/ Staff/ Year	250		
Avg. Hours/ Shift	8		
Total Annual Search Hours/ Staff	1000		250
Total Search Hours/ Year	10000		2500
Hours Saved/ Year			7500
Max. Avoided Hires			3.75
Anticipated Hires in Next Year	3	22%	1.95
Hourly Rate	20		20
Staff Costs Due to New Hires	\$ 120,000		\$78,000
Annual Savings			\$42,000

RFLS TCO

	Year 1	Year 2	Year 3	Year 4	Year 5
RFLS					
Infrastructure	\$350,000				
Install	\$10,000				
Maintenance	\$20,000	\$20,000	\$20,000	\$20,000	\$20,000
Disruption	\$4,000	\$1,000	\$1,000	\$1,000	\$1,000
Tags	\$65,000	\$7,000	\$7,000	\$7,000	\$7,000
Total	\$449,000	\$28,000	\$28,000	\$28,000	\$28,000

VOI Results

	Year 1	Year 2	Year 3	Year 4	Year 5
Benefits					
Equipment Cost Savings	\$320,825	\$320,825	\$320,825	\$320,825	\$320,825
Patient Throughput	\$1,729,276	\$1,729,276	\$1,729,276	\$1,729,276	\$1,729,276
Staff Productivity	\$252,000	\$252,000	\$252,000	\$252,000	\$252,000
Total Benefits	\$2,302,101	\$2,302,101	\$2,302,101	\$2,302,101	\$2,302,101
Costs					
RFLS TCO	\$449,000	\$28,000	\$28,000	\$28,000	\$28,000
Net Benefits	\$1,853,101	\$2,274,101	\$2,274,101	\$2,274,101	\$2,274,101
Cumulative Net Benefits	\$1,853,101	\$4,127,203	\$6,401,304	\$8,675,405	\$10,949,507
VOI	413%	865%	1268%	1628%	1952%

VOI Results (without patient tracking)

	Year 1	Year 2	Year 3	Year 4	Year 5
Benefits					
Equipment Cost Savings	\$320,825	\$320,825	\$320,825	\$320,825	\$320,825
Patient Throughput	\$0	\$0	\$0	\$0	\$0
Staff Productivity	\$252,000	\$252,000	\$252,000	\$252,000	\$252,000
Total Benefits	\$572,825	\$572,825	\$572,825	\$572,825	\$572,825
Costs					
RFLS TCO	\$449,000	\$28,000	\$28,000	\$28,000	\$28,000
Net Benefits	\$123,825	\$544,825	\$544,825	\$544,825	\$544,825
Cumulative Net Benefits	\$123,825	\$668,650	\$1,213,475	\$1,758,300	\$2,303,125
VOI	28%	140%	240%	330%	411%

Conclusions

- Strong economic drivers for RFLS in hospitals
- Requires purpose-built system
 - Room-level accuracy with high assurance
 - Low entry and lifetime costs
- Clear economic benefits
 - Positive VOI in first year

The logo for innerwireless features the word "innerwireless" in a blue, lowercase, sans-serif font. An orange arc is positioned above the "i" and "n". Below the main text, the word "presents" is written in a smaller, italicized, blue, lowercase, sans-serif font.

innerwireless
presents



Location awareness for healthcare

innerwireless.com