

Team Snoozers

PROTOCOL EVALUATION AND RECOMMENDATION

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Under the Guidance of:
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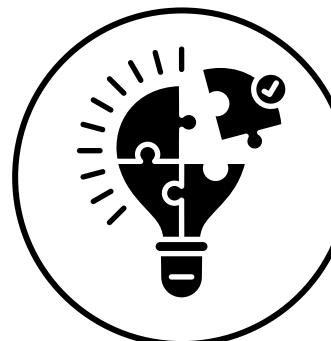
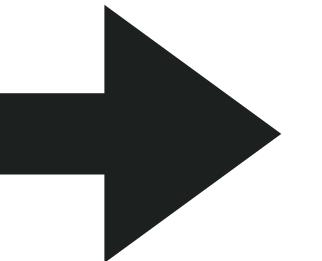


ALARM.COM®

EXECUTIVE SUMMARY



Which protocol should
Alarm.com integrate and
champion for the next 5 years?



Alarm.com should adopt **Thread**
and champion it for the next 5 years.

AGENDA

01 **Introduction**

02 **Interim Review**

03 **Protocol Review**

04 **Strategy and Risk Assessment**

05 **Economic Analysis**

06 **Recommendation**

MEET THE TEAM



Brinda Sai



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Alarm.com provides a platform for home and business automation and monitoring with a focus on integrating devices to create a cohesive experience

Crime Resistant

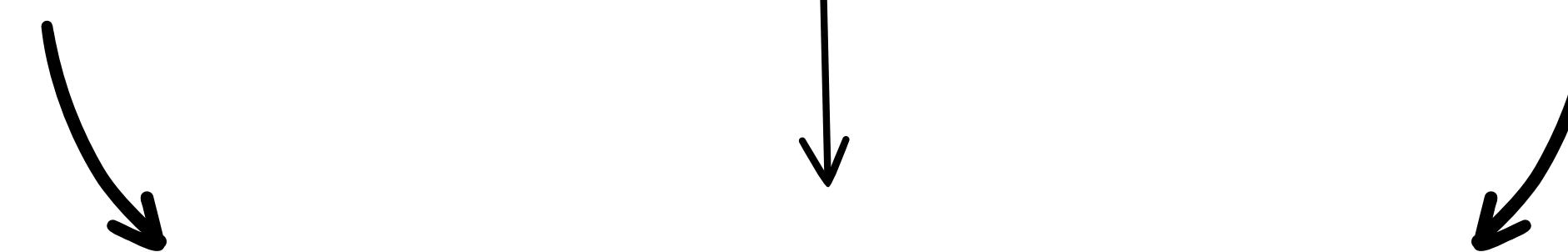
1. Doorbell
2. 2-way audio cameras
3. Z wave code
4. Security systems
5. Crash & smash technology

Energy Efficient

1. Smart HD thermostat
2. Z wave temperature sensor
3. Water valve & meter

Ultra Convenient

1. Scenes
2. Wellness platform
3. Pressure sensor
4. Pillbox
5. Stationery emergency button



Z-wave

Wireless Communication, Low Power Consumption, Interoperability

Alarm.com was an early champion of Z-Wave for ~15 years, but Z-Wave's future appears uncertain with rising hardware costs and a limited roadmap.



Situation

- The global home automation market is projected to grow at a CAGR of 14%
- Rising hardware cost of components such as chips
- Z-wave's adoption has been a challenge abroad
- The move to open source has led to increased unreliability of Z-wave protocol.



Key Question



Assessment

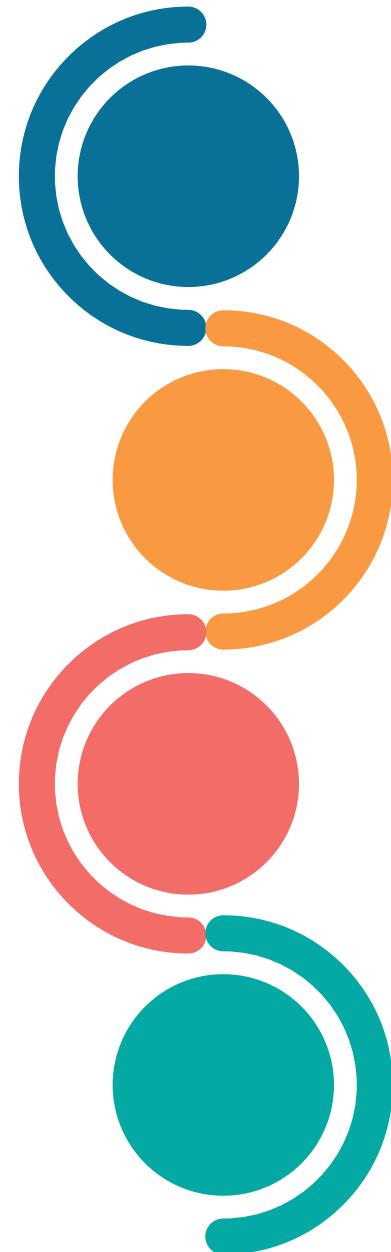
- Criteria evaluation of home automation protocols.
- Strategy and Risk assessment for Threads integration into Alarm.com.
- Economic analysis of the Threads.

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We evaluated **four protocols** for integration into Alarm.com's ecosystem



Zigbee

Wi-Sun

Matter

Thread



DARTMOUTH
ENGINEERING
THAYER SCHOOL

INTRODUCTION

INTERIM
OVERVIEW

PROTOCOL
REVIEW

STRATEGY AND
RISK ASSESSMENT

ECONOMIC
ANALYSIS

RECOMMENDATION

The **decision criteria** that we considered while assessing the protocols were

1 

Operating Frequency

Specific radio frequencies on which network operates

2 

Compatibility & Interoperability

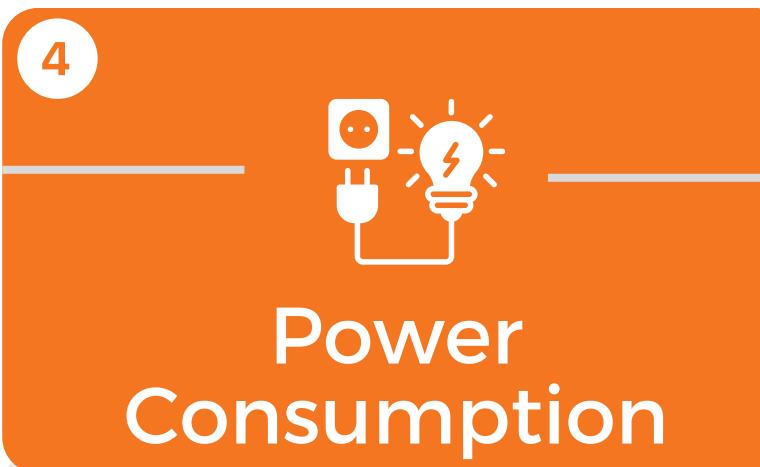
Ease of devices being compatible to network & each other in a coordinated form

3 

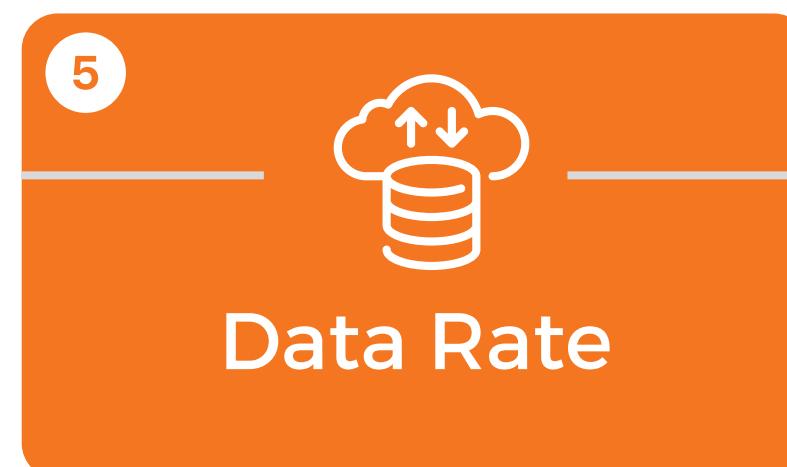
Latency

Time taken by data to reach from source to destination (closer to 0 is better)

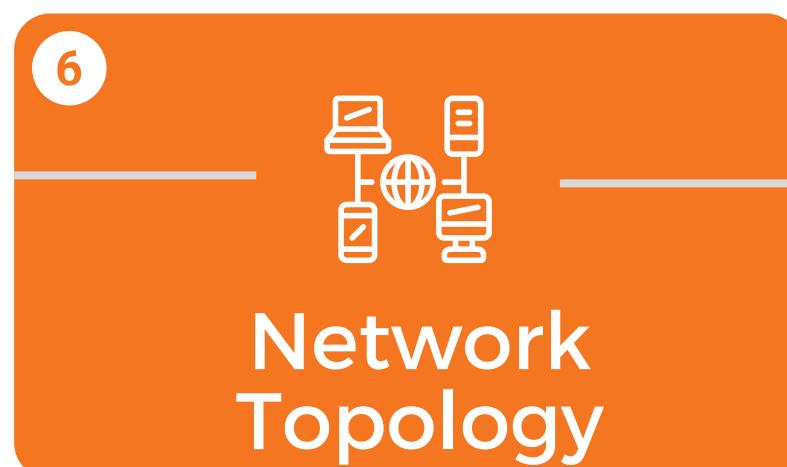
The **decision criteria** that we considered while assessing the protocols were



Energy consumed by protocol while sharing data



Amount of data transmitted during a specified time period over a network



Arrangement of nodes & lines in a network- star/mesh/point-to-point



Protocol evaluation based on decision criteria

Criteria	Criteria ranking	Thread	Matter	Zigbee	Wi-SUN	Condition
Operating Frequency	6	2.4	2.4/5	2.4	2.4	2.4 better than 5
Compatibility & Interoperability	5	Higher & can upgrade to matter	High	Low	Lower than Zigbee	Higher the better
Latency (ms)	4	80-100	20-150	80-130	20	Lower the better
Power consumption (mA) resting/listening	3	0.0016/0.037	0.1/0.5	26.5/28.5	0.002/8	Lower the better
Data rate (Kbps)	2	250	250	250	300	Higher the better
Network Topology	1	Mesh	Mesh	Star/mesh/cluster-tree	Star/Mesh	Case dependent

Decision Criteria

6 - Most Important Criteria

1 - Least Important Criteria

The decision matrix computes Thread & Wi-SUN to be the most competent replacement of Z-wave

Criteria	Criteria ranking	Weights	Thread	Matter	Zigbee	Wi-SUN
Operating Frequency	6	0.29	4	4	4	4
Compatibility & Interoperability	5	0.24	4	3	2	1
Latency (ms)	4	0.19	2	2	1	4
Power consumption (mA)	3	0.14	4	3	1	4
Data rate (Kbps)	2	0.10	3	3	3	4
Network Topology	1	0.05	4	4	4	4
Scores			3.52	3.14	2.43	3.29
<i>4-being the best, 1-being the worst</i>						

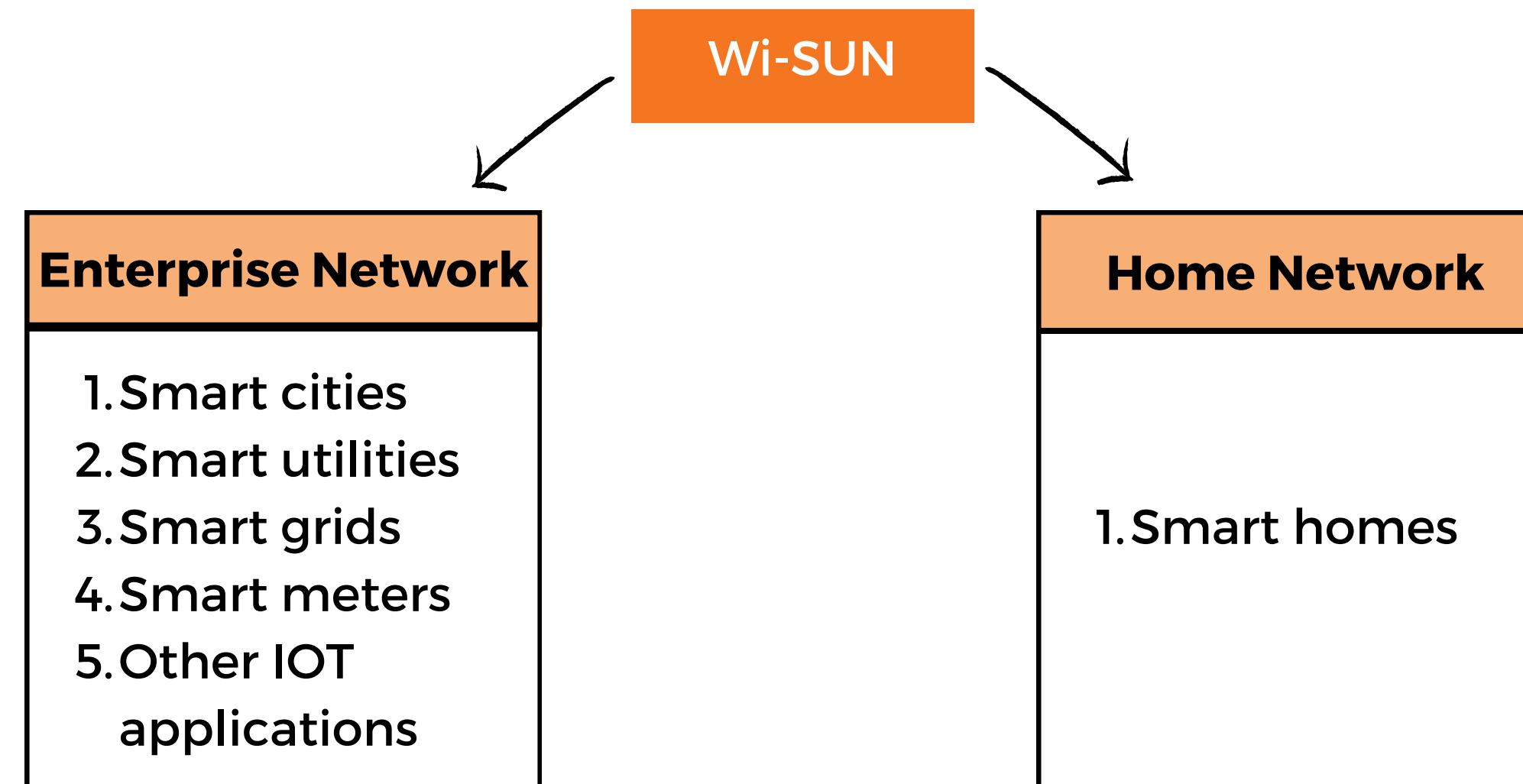
Note : Weights = Ranking of each criteria / Sum (All criteria rankings)

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Wi-Sun is extensively used in smart cities, industries, and businesses due to its long range of communication

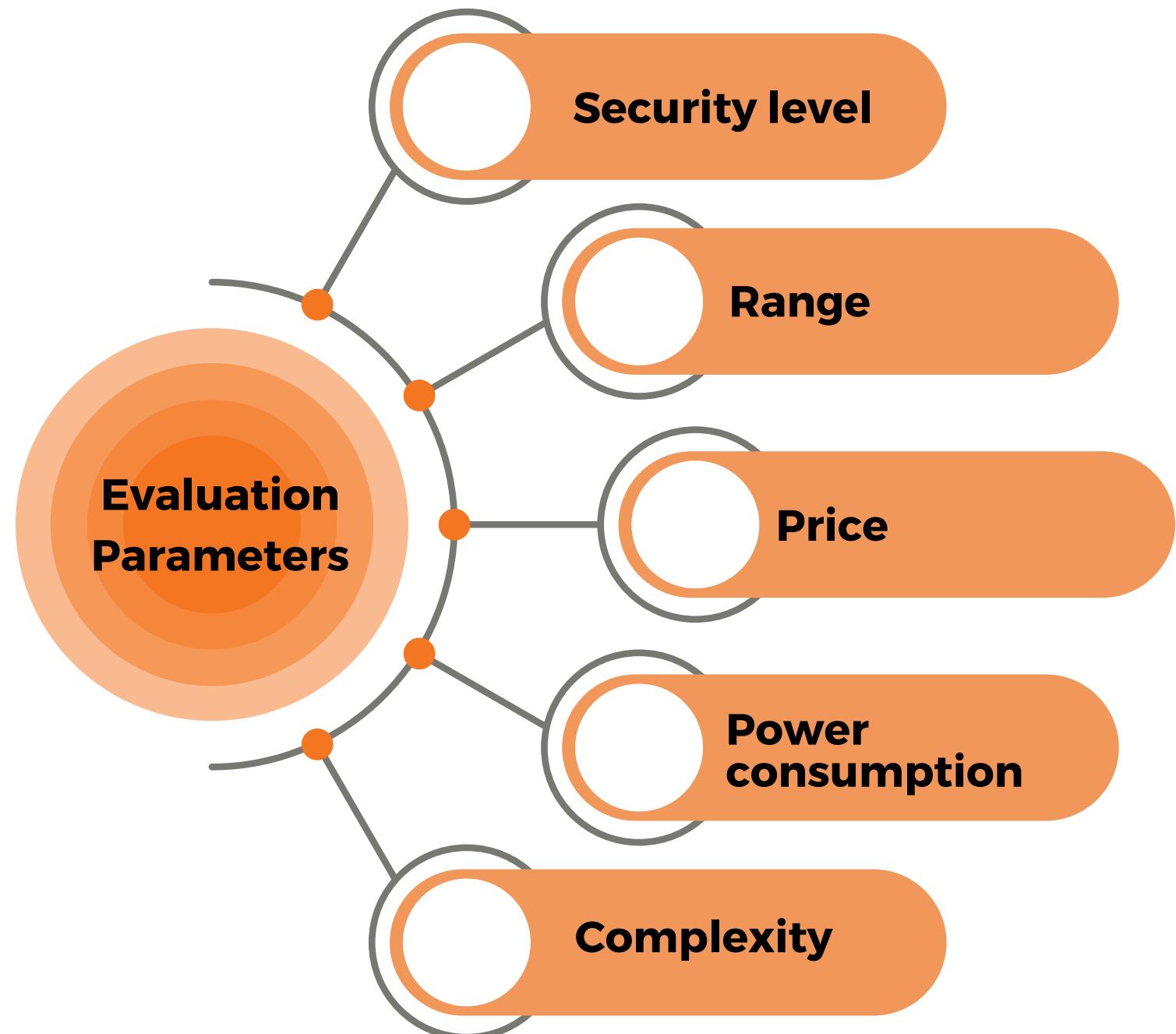


Current stakeholders

Enterprise, Universities, Municipalities and Local government organization

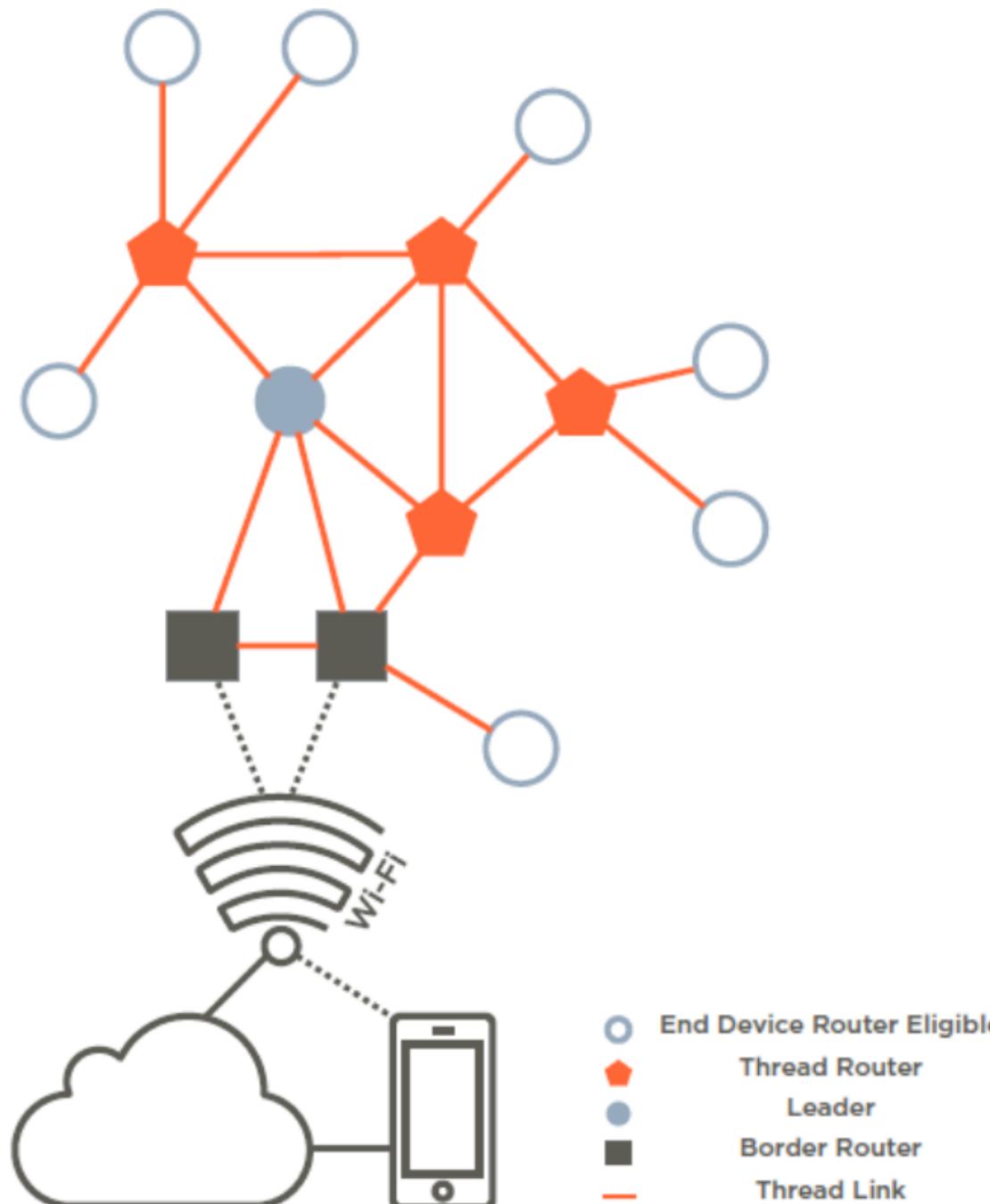
Sources: LinkedIn pages, SINBON article, Wi-SUN eBook

Wi-Sun is un-suitable to be integrated into Alarm.com's current landscape



Wi-SUN's goal is to master home automation in the next 5 years

Thread, with its mesh networking and self-healing technology, is well-suited for seamless integration into Alarm.com's ecosystem.



Highlights

- Low-power, secure, and ipv6-based wireless mesh protocol
- Operates in the 2.4 GHz band and Licence-free band
- Self-healing technology
- Promoted by Thread Group which is backed by big players like Google, Amazon, Samsung, Apple, etc

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Market analysis of the home automation industry



Buyer Power (Moderate)

Dealers and Installers, Homeowners

- Buyers switching costs to alternate solutions
- Cost of product
- Product differentiation



Supplier Power (High)

Thread Group, Hardware component supplier

- Component scarcity
- Buyer's price sensitivity
- Bargaining power



Threat of Substitute/ New Entrance (Moderate)

Amazon, SimpliSafe, Vivint

- Certification cost
- Relative prices and performance of substitute
- Product differentiation



Industry Rivalry (High)

Amazon, SimpliSafe, Vivint

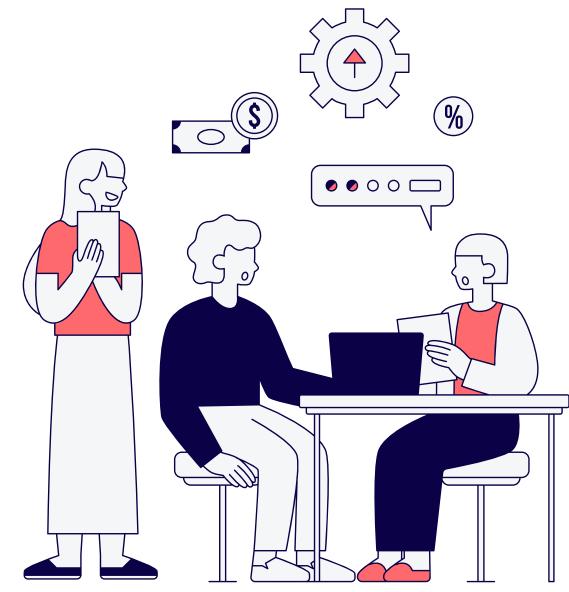
- Product and Service differentiation
- Cost and Pricing conditions
- Limited protocols

Comprehensive **strategy** for Thread integration into Alarm.com



Capability Assessment

- Evaluate licensing and device costs with Threads
- Evaluate internal engineering team capabilities
- Evaluate service cost for Z-wave for 10 years



Coordinate with stakeholders, Implement, and Test

- Analyze supply chain for distribution of Thread based devices
- Pilot project to small scale, validate performance, and launch products



Marketing and Rollout

Partners :

- Incentivize partners for early switching to Thread
- Cheaper Thread based devices

Customers:

- Reduced failure rate of devices
- More modern and scalable solution [IPv6]



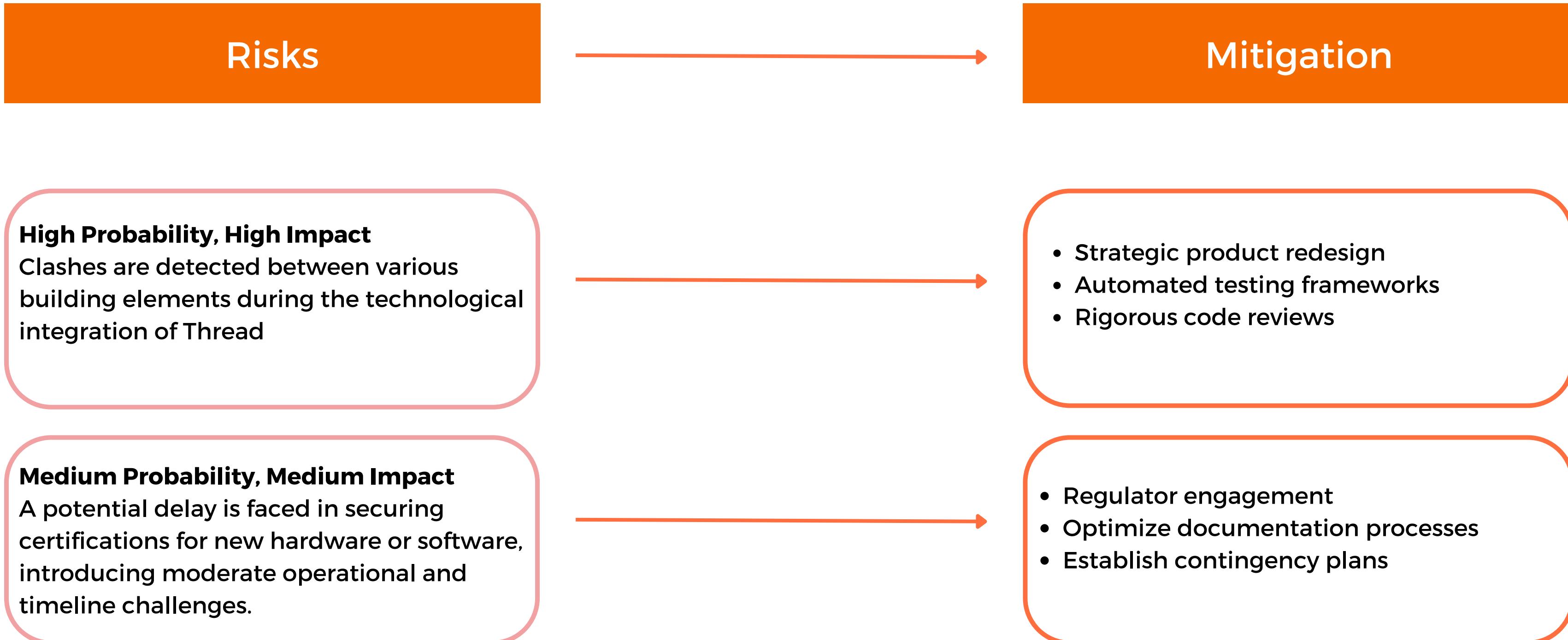
Monitoring and Maintenance

- Collaborate with local vendors to provide enhanced after-sales services
- Ensure after-sale service of Z-wave

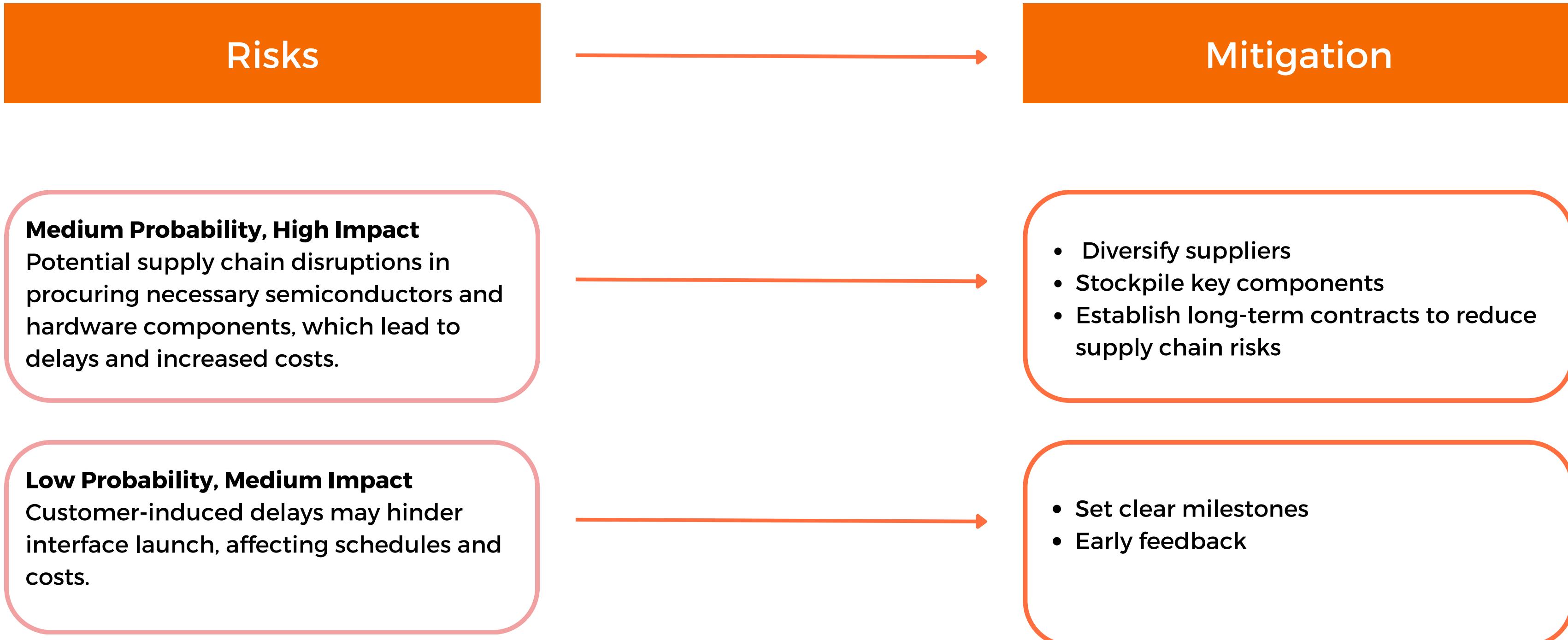
Deep dive into risk assessment and mitigation strategies for effective Threads integration



Evaluating risks through an analysis of impact and probability criteria, and proposing mitigation strategies



Evaluating risks through an analysis of impact and probability criteria, and proposing mitigation strategies

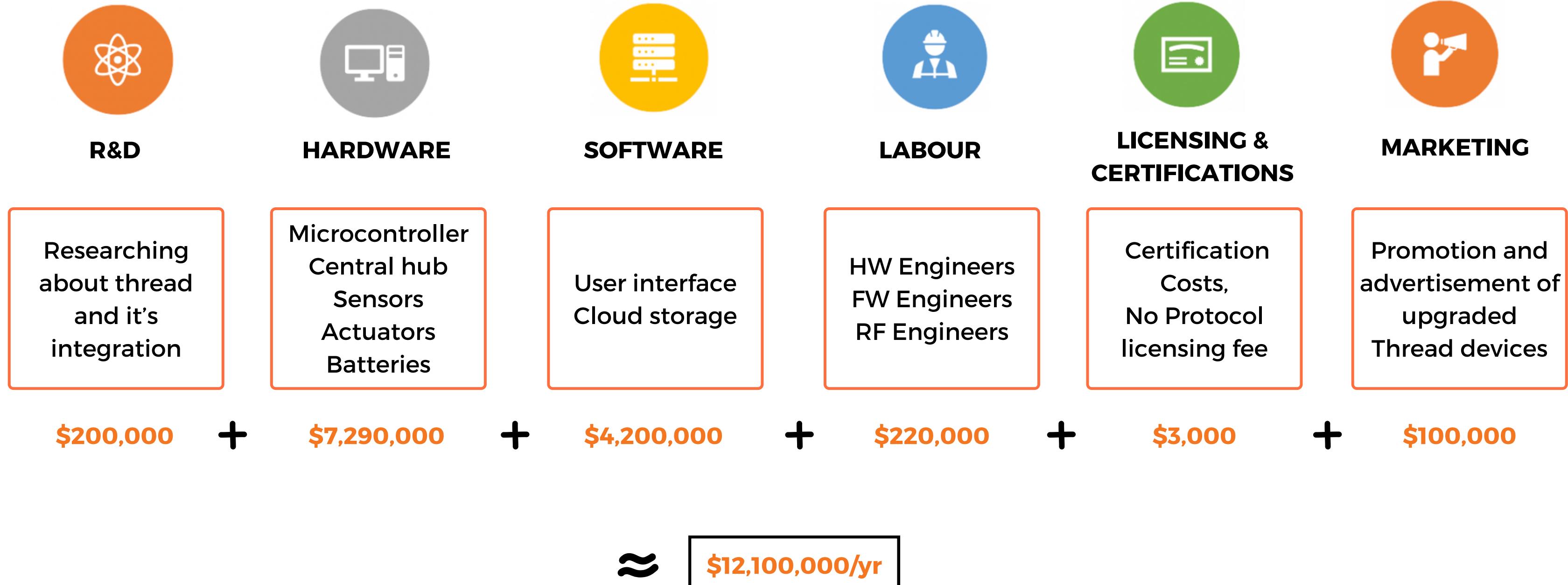


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Factors considered in the Cost Analysis

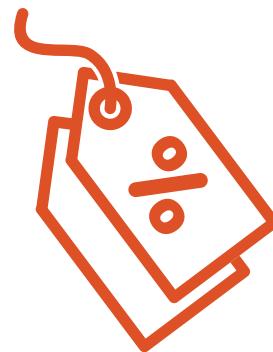


The total cost of implementing Threads is **less** than that of Z-Wave

FACTORS PROTOCOLS	Z-WAVE	THREAD
R&D	\$150,000	\$200,000
HARDWARE	\$9,240,000	\$7,290,000
SOFTWARE	\$4,200,000	\$4,200,000
LABOUR	x	x + \$220,000
LICENSING & CERTIFICATIONS	\$1,000	\$3,000
MARKETING	\$75,000	\$100,000
TOTAL	\$13,666,000	\$12,013,000

Note : Assuming 10,000 orders per year

Offering discounts to incentivize users to switch from Z-wave to Thread based devices



Introductory discount

Give significant discounts to products with Thread protocol (~ \$170)

Convincing customers to switch

Market Thread products as an ‘Enhanced’ version of the old products



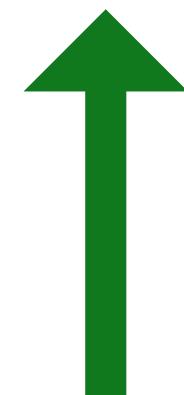
How has implementing Threads **reduced costs and added value**



It reduces cost



- Reduced hardware cost
- Reduced operating cost
- Reduces overall cost by ~ \$1.7M



It creates value



- Compatible with more devices; more competitive advantage
- More up-to-date protocol
- Better value proposition
- Increased revenue



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Alarm.com's penetration into new markets leveraging existing security offerings and exploring new frontiers

Existing technology, New Market



Financial Institutions

IT firms



Retail stores



Healthcare

New technology, New Market



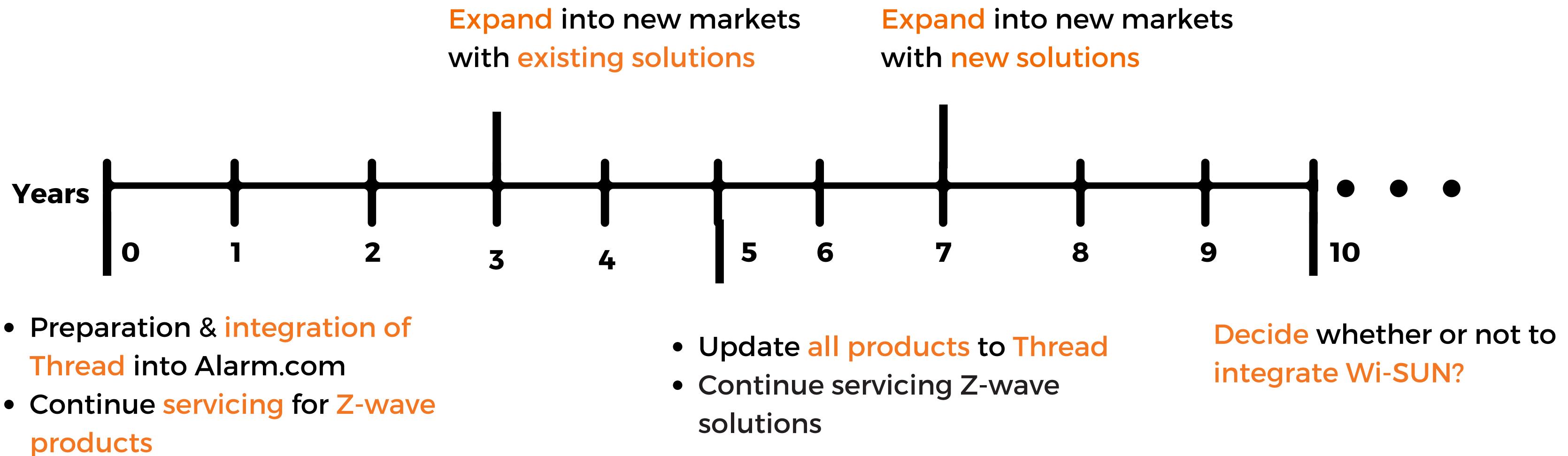
Minimal product change with high impact

- Controls robots and machines in assembly lines
- Quality control inspection
- Inventory management

Significant change in products

- Autonomous vehicles
- Controlling MRI, robot surgery machines & patient monitoring
- Smart agriculture

Comprehensive roadmap to enhance Alarm.com's longevity via Thread integration



THANK YOU



REFERENCES

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- <https://www.intuz.com/blog/matter-compares-against-other-smart-home-standards>
- <https://www.qorvo.com/design-hub/blog/matter-gets-everybody-talking>
- <https://www.precedenceresearch.com/home-automation-market>
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- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9105712/>
- <https://www.youtube.com/watch?v=pwi1fEUFn7M>
- <https://www.silabs.com/documents/public/user-guides/ug103-11-fundamentals-thread.pdf>
- <https://www.sciencedirect.com/science/article/pii/S1877050914010217>

APPENDIX

What does Alarm.com do?

Makes setting up of smart home easy

- Crime resistant
- Energy efficient
- Ultra convenient

History

Started in 2000 from a data analytics company, much of which is involved in their smart property

Products

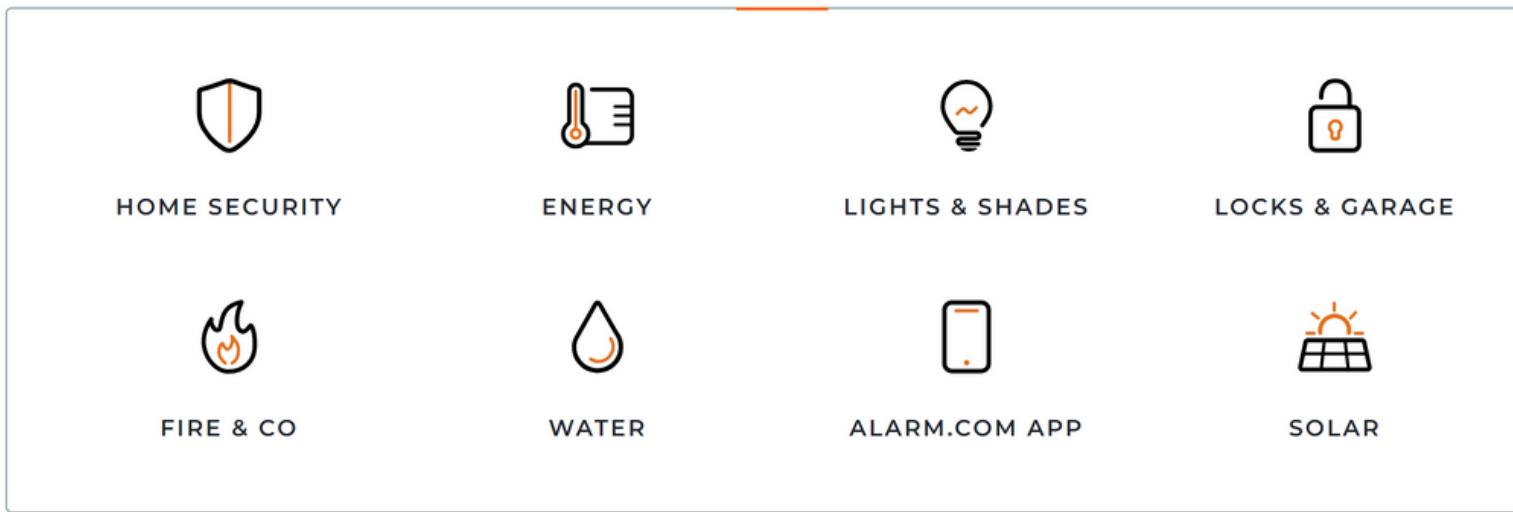
1. **Doorbell**- Sends notification to alarm.com app -> live action/ phone call
2. **Z-wave app**- Lock/unlock door & garage door, control lights, arm & disarm security systems, remotely control all Alarm.com products at home
3. **Cameras**- Multiple to track motion, 2 way audio camera (Perimeter Guard) -> allows communication with outside people, siren goes off for intruders, talk to delivery man, use for a phone call too
4. **Analytics**- Differentiates between humans, animals & vehicles -> smarter notifications, pattern learning and analysis after 30 days to notice the uncommon
5. **Z wave code**- Different for each family member, temporary codes for contracting
6. **Security systems**- Core of Alarm.com, life saving operations -> live connected (**central monitoring system/station**) leads to authorities being aware during a burglary with proper dispatchers arriving
7. **Crash & smash technology**- burglar hammers panel -> system will still send notification to central station & send dispatchers
8. **Smart HD thermostat**- Award winning thermostat -> control temperatures, reduces energy cost by setting optimal temperatures when not at home (geofencing) or when at work (schedules - 9 to 5 everyday)
9. **Z wave temperature sensor**- Maintain avg temp. throughout an area -> baby's nursery/ offices
10. **Scenes**- Control multiples devices using one click -> wake up/ sleep, lock all doors, dinner time - **Voice controlled**
11. **Wellness platform**- Look after age old people -> normal activity & pattern analysis
12. **Pressure sensor**- On bed -> avg. sleeping hours, grandparents have returned to bed or not
13. **Pill box**- Notifies if parent has not opened the box/ did it fewer number of times
14. **Stationery emergency button**- Notifying & sending dispatchers, keep is bedroom/bathroom (slip & fall)
15. **Swipe cards**- Mainly for businesses and higher end projects -> give access to certain rooms with a good card, also used for the wiring room (wires, stream video recorder (has video content from camera available for live use other than cloud), **solar edge inverter**- monitor energy usages and production through solar panels
16. **Water heater/bug**- shuts off water during floods
17. **Water valve & meter**- shows usage, shuts off during leak on notification
18. **Connected car**- battery life of car, diagnostic alerts, oil consumption, mileage, connect with home devices to scene it when you're 1 mile away
19. **Smart plugs**- switch on coffee device in the morning without getting up from bed
20. **CO and smoke detectors**- monitor and notify

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Provides services to-

1. Homes
2. Small & commercial businesses
3. K12 schools
4. Light industrial operations
5. Retail
6. Food & beverage

Customized according to- property type, location, personal needs, type of crime etc.



Our Hardware Partners

Our best-in-class software is seamlessly integrated into the industry's most advanced hardware systems.



For businesses-

1. **Enterprise dashboard for businesses**- Integrates energy efficiency, smart locks, intrusion, video monitoring of businesses in different locations in the world -> make informed business decisions
2. **Business activity analytics**- people counting, heat mapping, occupancy, busiest time of the day, Queue monitoring, weekly/monthly/quarterly reports on business functions tracked

APPENDIX

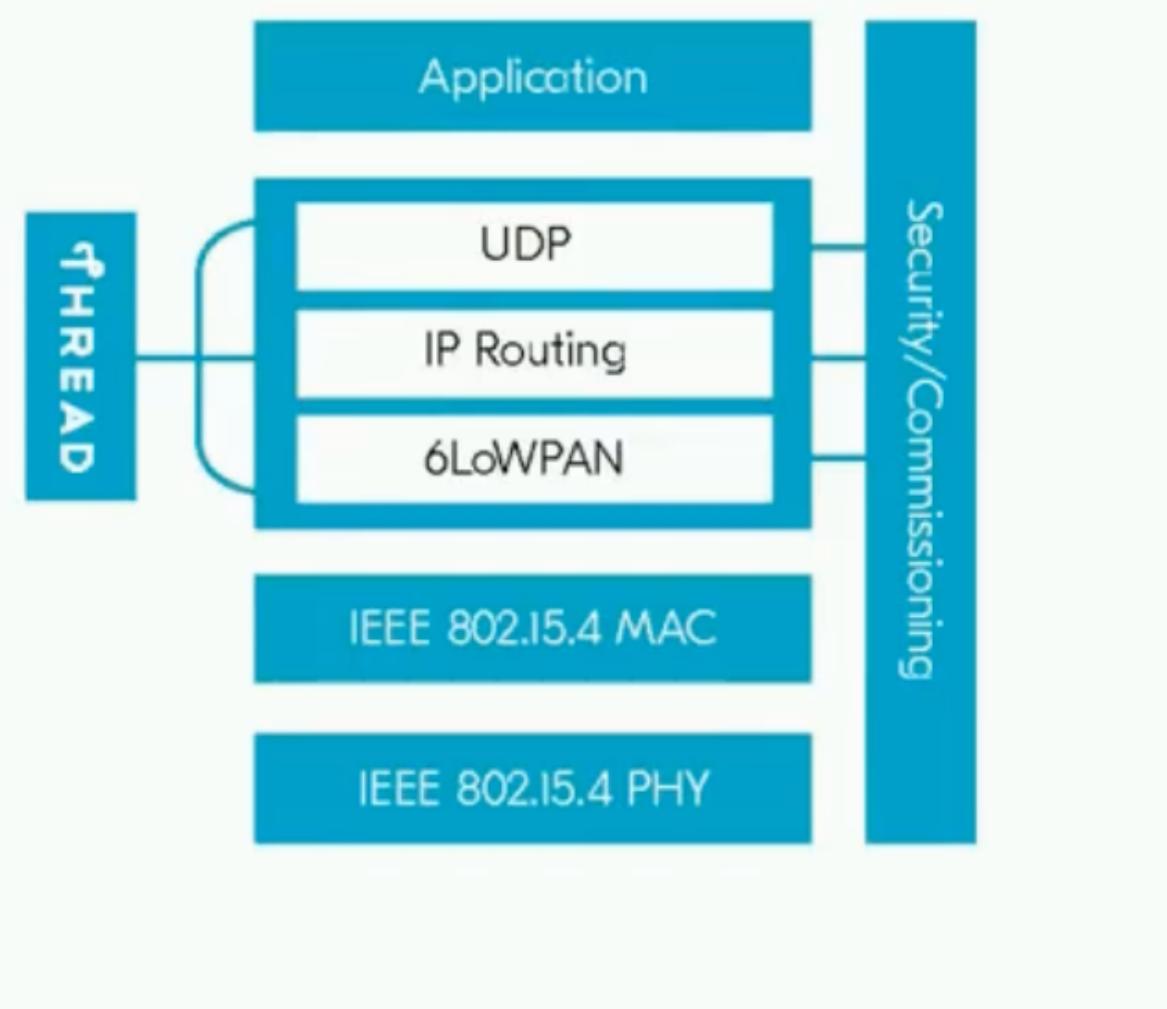
Network protocol

Thread:

- Thread is a low-power, secure, and ipv6-based wireless mesh protocol.
- This protocol operates in the 2.4 GHz band which is a Licence-free band.
- This is based on 6 Low Pan.
- Thread protocol is going to play an important role in matter protocol which is promoted by CSA(Connectivity Standards Alliance).
- Thread is promoted by Thread Group which is backed by big players like Google, Amazon, Samsung, Apple, etc.

Device Roles-

- **Thread Router:** This device forms the backbone of the network for extending the range and coverage. The router receives the data and forwards it to the nearby device which is in the range. The radio of this device is always on. The device is generally mains powered. It can play the role of parent for the End Device
- **Leader Router:** It is elected by the Routers in the network. This device takes decisions regarding role upgrades, commissioner, and controlling routers.
- **Border Router:** This device works as a link between the thread network and cloud or other non-thread network through wifi and thread
- **Thread End Device:** This device sleeps most of the time and wakes up to send the data or poll the parent router to get the data. It is generally a sensor device operating on a Battery. The end device is connected to the Parent Router to communicate with the rest of the network. It does not forward the messages.
- **REED or Router eligible End device:** It is a device that can change its role to become a router if the need arises to strengthen the network.



- Built on proven technologies
- IEEE 802.15.4 - the same radio as used for the Zigbee networking protocol
- IPv6 and 6LoWPAN - Thread is an Internet Protocol version 6 (IPv6) based mesh network. 6LoWPAN defines how to send IPv6 packets over 802.15.4
- No application layer defined

APPENDIX

Network protocol- Rules & regulations followed by networking devices to transfer data (same language)

Packets- Data transferred in small pieces with security from sender to receiver

Wi-Sun:

Incorporated as Not for profit organization - Delaware, US, 2012
Europe, India, North America, Japan & Singapore
Field area network (FAN) & Home area network (HAN)

Properties-

1. Open standards based mesh network - useful for home automation as interconnected nodes allow entire smart home to be integrated with a central controller
2. Running on Sub GHz - useful for long range and low power communications (< wifi, bluetooth which function on 2.4GHz)
3. Based on IEEE 802.15.4g
4. Based on IPV6 protocol
5. Robust & Self-healing networks
6. Uses frequency hopping to increase robustness
7. Designed for large scale networks up to 1000 nodes
8. Line powered + border routers -> gateways to other layers of networks
9. Ensures scalability, interoperability

Usage-

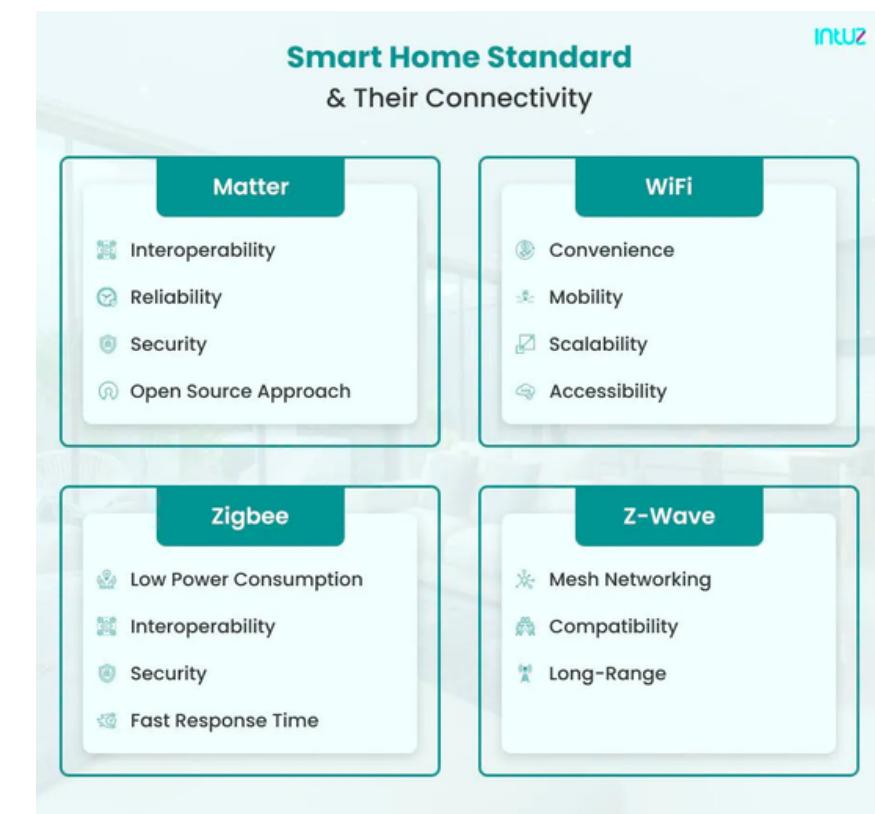
1. Large scale network, ranging up to KMs.
2. Mainly for smart city network- smart lighting, metering & EV charging
3. In Home automation-
 - a. **Smart lighting**- Dimming, scheduling, occupancy sensing
 - b. **Smart metering**- Monitor to reduce cost and increase energy efficiency
 - c. **Smart thermostats**- Control temperature
 - d. **Home security**- Cameras, motion detectors, door/window sensors- ensures security over a long range
 - e. **Smart water management**- Controls leaks, irrigation system and water usage
 - f. **Environmental monitoring**- Temperature, humidity and air quality outside home
 - g. **Smart appliances**- Connect washing machine, ovens and refrigerator
 - h. **Asset tracking tag**- Helps track keys or wallets

Disadvantage of Wi-SUN for home automation

- a. **Complex setup**- Not user friendly for average consumers
- b. **Limited device compatibility**- Compared to Zigbee and Zwave
- c. **Interference**- Can work with wifi, but interference from devices with sub GHz can affect performance
- d. **Security**- Requires appropriate encryption and authentication
- e. **Cost**- Can be expensive compared to other protocols, not suitable if home owner is not very rich
- f. **Limited data throughput**- Due to focus on long range communications and power efficiency, no high speed data transmission

In a nutshell,

Well established and extensive ecosystem- Zigbee
Strong industry backing & IP support- Thread & Matter
Long range & outdoor capabilities- Wi-SUN



APPENDIX

	1	2	3	4	5	6	7	8	9
Security	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>					
Network Topology (Star or Mesh)	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
Cost	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>					
Compatibility & Interoperability	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Power consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data rate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Latency & Reliability	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Range & Coverage	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Operating Frequency	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Wi-SUN and home automation

[Linkedin](#)

1. The Wi-SUN Alliance is a global non-profit member-based association made up of industry leading companies. Its mission is to drive the global proliferation of interoperable wireless solutions for use in smart cities, smart grids and other Internet of Things (IoT) applications using open global standards from organizations, such as IEEE802, IETF, TIA, TTC and ETSI. With more than 180 members worldwide, membership of the Wi-SUN Alliance is open to all industry stakeholders and includes silicon vendors, product vendors, services providers, utilities, universities, enterprises and municipalities and local government organizations. For more information, please visit: www.wi-sun.org.
2. Wi-SUN NICs play a crucial role in enabling reliable and secure communication for smart meters. The technology provides advantages such as open standards based, self-healing mesh capabilities, and interoperability for large-scale outdoor IoT networks.
3. In a new blog President and CEO Phil Beecher for Wi-SUN Alliance talks with Abhijit Grewal, Senior Marketing Director Smart Cities at Silicon Labs, about the company's work with the International Institute of Information Technology in Hyderabad, India and the role of Wi-SUN mesh technology in supporting its Smart City Living Lab project.

SINBON

The Wi-SUN technology is applicable to the 2 following areas:

Field Area Network (FAN):

An indispensable technology in smart cities. Common application scenes include smart factories, smart street lights, smart buildings, and so on, to connect public infrastructures and achieve interoperability.

Home Area Network (HAN):

Through the home energy management systems (HEMS) controllers, users can link the smart meters with smart appliances (such as a Roomba or an air conditioner, etc.). Besides monitoring their live power consumption, users can also integrate smart households into the smart city by connecting the smart meter and FAN-based smart city applications.

Wi-SUN eBook

<https://wi-sun.org/wp-content/uploads/Wi-SUN-eBook-Smart-City-and-IoT-r21.pdf>

Where do you see Wi-SUN FAN applications in the next five years?

Wi-SUN's goal is to support Smart utilities, Smart cities, Smart home, and M2M. Even though there is already a lot of activity in all four of these areas, we are still only at the very early stages of the growth curve. Historically the technologies used to service these use cases have been very fragmented. We think Wi-SUN will be the one of the technologies that brings all these applications together. These applications all need network infrastructure that provides reliable, secure communications at scale - and Wi-SUN can provide all of that.

What new application opportunities do you see for Wi-SUN technology?

There are opportunities for Wi-SUN HAN network solutions to integrate with Bluetooth Low Energy (BLE) and offer more versatility for smart home applications than is possible with Wi-Fi and Zigbee. We have begun preliminary research and development on products that would employ a new version of Wi-SUN technology as the LPWANs and related sensors used in water and gas metering.

Why is Wi-SUN not being preferred for home automation ?

- Wi-SUN is designed for large-scale deployments with a focus on utility companies and industrial applications. For most home automation scenarios, simpler and more cost-effective wireless protocols like Wi-Fi, Zigbee, Z-Wave, or Bluetooth are sufficient.
- Complexity: Wi-SUN is a complex and highly secure protocol, which may be unnecessary for most home automation systems. Simplicity and ease of use are often preferred in consumer applications.
- Power Consumption: Home automation devices often require low power consumption to maximize battery life, especially for battery-operated devices like sensors. Other wireless standards like Zigbee and Z-Wave are optimized for low power usage, while Wi-SUN may be less efficient in this regard.

Interoperability: In the context of home automation, there's a significant focus on interoperability between different devices and ecosystems. Wi-SUN may not have the same level of compatibility and interoperability as more established home automation standards.

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Different uses of Thread protocol in automation-

1. **Manufacturing**- Control robots and machines on assembly lines
2. **Inventory management**- Track orders, update inventory levels, reduce inventory discrepancies
3. **Traffic control**- Change traffic lights during the right time and maintain data efficiently
4. **Energy grid management**- Controls and monitors generators, substations and distribution networks of energy
5. **Autonomous vehicles**- Decision-making, sensors, control systems for safe and efficient navigation
6. **Healthcare**- MRI machines, robot surgery machines and patient monitoring equipment
7. **Agriculture**- Planting, harvesting and irrigation systems
8. **Manufacturing quality control**- Inspection of finished products
9. **Environment monitoring**- Collect and measure air and water quality, pollution levels

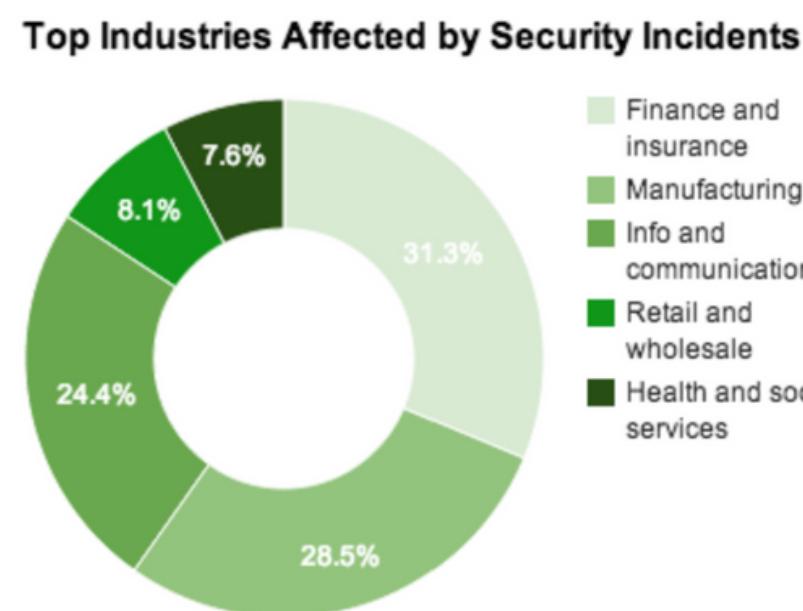
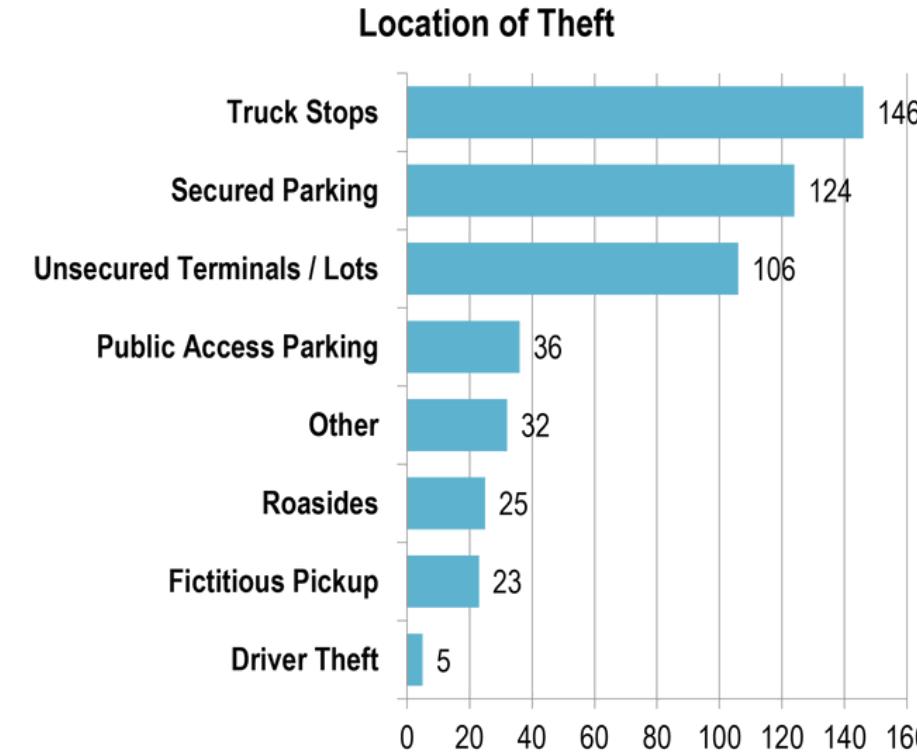
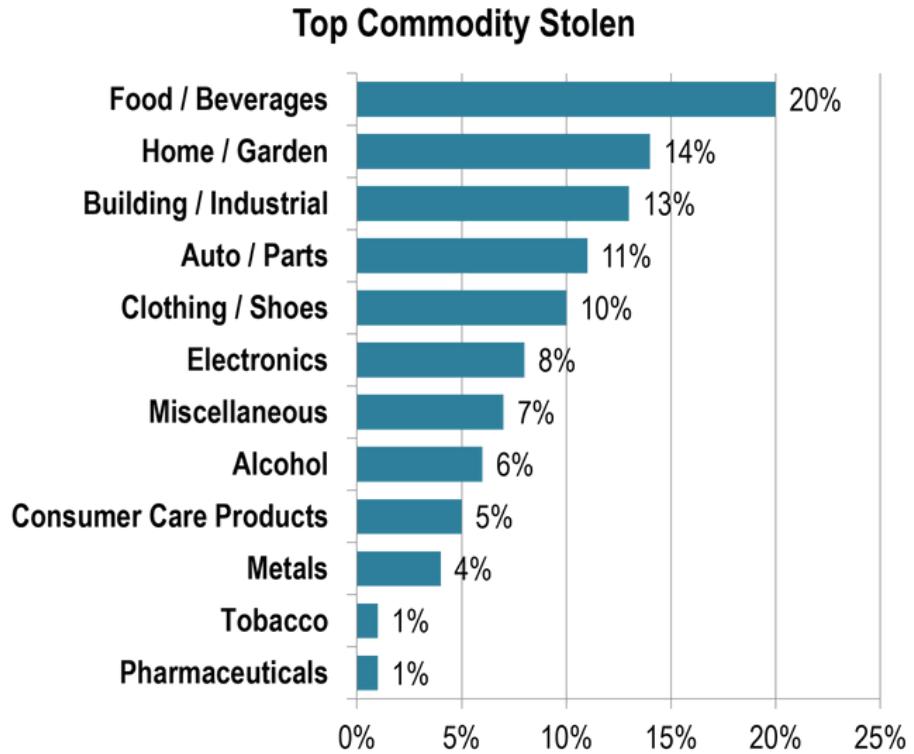
Entering new markets:

1. **Comparatively minimal change in products with high impact**
 - a. Manufacturing
 - b. Manufacturing quality control
 - c. Inventory management - similar to security systems, update when inventory is low. But requires more work in terms of being able to track orders
2. **Comparatively significant change in products**
 - a. Autonomous vehicles - too advanced
 - b. Healthcare - similar for patient monitoring system, more work in case of MRI and robot surgery machines
 - c. Agriculture - similar but requires much more programming and advancements for change
3. **Unrelated field or lesser impact**
 - a. Traffic control
 - b. Energy grid management
 - c. Environmental monitoring

Highlights: The Most Important Statistics

- Robots carried out 50% of total manufacturing work worldwide in 2021.
- By 2023, global spending on robotics and related services is projected to reach 241.4 billion U.S. dollars.
- By 2025, the Industrial automation market is expected to reach \$296.70 billion.
- On average, automating a task in manufacturing can save 16 hours of human work per week.
- The smart manufacturing market will grow at a CAGR of 12.4% by 2027.
- Sixty-seven percent of manufacturers have accelerated their production automation plans.
- Nearly 90% of manufacturing companies report that automation has accelerated in their workplace due to the COVID-19 pandemic.
- In the next five years, 42% of total task hours will be done by machines.
- The global automotive robotics market size was valued at USD 5.47 billion in 2020.
- By 2027, the Asia-Pacific region is projected to hold the largest share in industrial automation at around 46%.
- The PLC (Programmable Logic Controller) market in India is expected to grow at a compound annual growth rate (CAGR) of nearly 5% till 2023.
- More than one-third (38%) of businesses have witnessed speed improvements of up to 20% through automation.
- Companies are expected to add approximately 6% average increase in the number of robotic machines between 2020-2022.
- By 2030, around 83% of jobs involving repetitive tasks could be done by robots in the manufacturing industry.
- In 2021, 24% of manufacturers globally integrated AI platform-wide - a significant increase from the 8% measured in 2019.
- 60% of manufacturers will depend on artificial intelligence (AI) platforms for driving digital transformation across the supply chain by 2021
- Data analytics (57%) and AI (45%) are the most commonly used technologies for improving the prediction of equipment failure in manufacturing plants.
- In 2030, Germany's 4 million manufacturing job positions, 1.5 million could be automated.
- By 2025, China is planning to be 40% automated in their manufacturing industry.
- The Internet of Things (IoT) in the manufacturing market is expected to reach 53.8 billion US dollars by 2025.

APPENDIX



An agreed-upon direction or set of actions intended to

- Achieve a sustainable competitive advantage for a company
- More completely achieve the mission of the organization - an extension of the organization's Vision or Mission.

Potter's 5 forces:

Buyers:

- Customers: Homeowners, Renters, Small Business Owners, Smart Home Enthusiasts
- Clients (Present): Security Companies, Property Management Companies, Dealers and Installers
- Customers/Clients (Future): Commercial Market - Large Enterprises, Healthcare Facilities, Energy management

Suppliers/Vendors: Protocols agencies, suppliers of hardware components, Cloud service provider,

Stakeholders: Hardware device suppliers and dealers.

- People supplying protocol, Taking care

Competitors: Potential Entrance and Substitute

Complement:

- People and talent
- Product and Services
- Org Infrastructure and Technology

APPENDIX



- 1- Lower
- 2-Low
- 3-High
- 4-Higher

Other industries Alarm.com can enter into with lower impact

5. Government and public institutions

6. Educational institutions

7. Residential security

8. Hotels and resorts

9. Entertainment venues

APPENDIX

Labour costs-

Labour costs	Duration(months)	Amount	Salary/year	Salary for project
Hardware engineers	4	2	98574	65716
Firmware engineers	4	3	117451	117451
Radio frequency engineers	4	1	98574	32858
		Total	216025	

Software costs-

	Data usage/month in GB	Data usage/year in GB	Quantity/house	Cost of data storage in cloud (\$)
Security camera	60	720	7	292.32
Thermostat	0.05	0.6	2	0.0696
Doorbell	175	2100	1	121.8
Smart plugs	0.05	0.6	15	0.522
Smart bulbs	0.05	0.6	20	0.696
			Total cost of storage	415.4076
				\$420
			Total cost for 10,000 orders	4200000

Cost of data per GB = \$0.058

APPENDIX

No. of microcontrollers-

	No. of microcontrollers
Sensors - Door & Windows	8
Smart bulbs and switches	20
Smart thermostats	1
Smart hubs	3
Security cameras	7
	39

Hardware costs-

	Z-wave	Thread	
	<i>unit cost</i>	<i>unit cost</i>	<i>Quantity</i>
Microcontroller	15\$	10\$	39
Batteries	\$4	\$4	6
Actuators	\$315	\$315	1

	Z-wave	Thread	
Microcontroller	\$585	\$390	
Batteries	\$24	\$24	
Actuators	\$315	\$315	
Total cost	\$924	\$729	
Total cost for 10,000 orders per yr	\$9,240,000	\$7,290,000	

Exhaustive list of hardwares-

	Z-wave	Thread
Hardware	<i>unit cost</i>	<i>unit cost</i>
Microcontroller	15\$	10\$
Sensors		
Motion Sensors	\$35	\$35
Door/Window Contact Sensors	\$35	\$35
Temperature Sensors	\$20	\$20
Light Sensors	\$20	\$20
Smoke and Carbon Monoxide Detectors	\$50	\$50
Actuators		
Servo Motors	\$20	\$20
Electric Linear Actuators	\$200	\$200
Solenoid Actuators	\$30	\$30
Motorized Valves	\$20	\$20
Stepper Motors	\$25	\$25
Relays	\$20	\$20
Batteries		
Alkaline Batteries	\$0.50-\$2	\$0.50-\$2
Lithium Batteries	\$1-\$5	\$1-\$5
Rechargeable Batteries	\$2-\$10	\$2-\$10
Coin Cell Batteries	\$1-\$3	\$1-\$3
Button Cell Batteries	\$1-\$3	\$1-\$3

APPENDIX

R&D and Marketing-

Departments					Average cost	Additional cost for Thread	Total cost
Sales and marketing	23,861	23,057	74,278	69,182	47,595	50,000	~100,000
Research and development	61,014	55,581	183,840	161,227	115,416	80,000	~200,000

Discount calculation-

Z-wave total cost	\$13,666,000
Thread total cost	\$12,013,000
Switching profits	\$1,653,000
Reduction in additional initial projects labour	\$220,000
Discount	\$1,873,000
Discount for each order	\$187

Additional Threats and Mitigation Strategies

