



TO: Greg Walker – Continental Automation Buildings Association
1173 Cyrville Road, Suite 210 Ottawa, ON K1J7S6
FROM: Glen Allmendinger and Alex Glaser
DATE: 23 July 2018
RE: Connected Home Roadmap – Technical Proposal

Evidence of Knowledge and Experience (13.2, 14.2)

Founded in 1984, Harbor Research Inc. has more than twenty-five years of experience in providing strategic consulting and research services that enable our clients to understand and capitalize on emergent and disruptive opportunities driven by information and communications technology.

Our firm has been involved in the development of the smart systems and machine-to-machine (M2M) market opportunity since 1998. The firm has established a unique competence in developing business models and strategy for the convergence of pervasive computing, global networking and smart systems. Our extensive involvement in developing this market opportunity, through research and consulting, has allowed the firm to engage with clients in the technology supplier community – both large and emergent players – as well as a diverse spectrum of device OEMs and services providers as well as broad end customer interactions.

Highlights related to our experience include:

- The first comprehensive research study on the Intelligent device networking and M2M arena in 1999;
- Smart systems forecast modeling work since 2002;
- October 2005 Harvard Business Review article “Four Strategies For The Age of Smart Services” (we were the firm that “named” the concept of Smart Services);
- Over forty-five white papers to date on various opportunities related to smart devices and services;
- Launch of SmartSphere in 2016, first online platform to map relationships of top companies in the IoT space, analysis of 500 players including many in the smart buildings market and custom news tracking software against Harbor’s taxonomies;
- Work with leading Connected home and Buildings constituents (Cimetrics /Analytika, Skyfoundry, Eaton Residential Business, Tridium, Optimum Energy, Johnson Controls, Pacific Controls, Jones Lang LaSalle, Samsung, Schneider Electric, Honeywell);
- Work with a broad spectrum of connected home network equipment and silicon suppliers (Cisco, Dell, HP, IBM, Samsung, AT&T, Verizon, Intel, Qualcomm, Microsoft, etc.);
- Work with leading data and analytics and artificial intelligence developers and vendors including Microsoft, Brain Corporation, Glassbeam, Google, Facebook, Samsung, and IBM;
- Work with what we believe is the largest community of device manufacturers focused on developing Smart Device and Smart Services solutions;
- Collaborated with CABA in 2017 on identifying key demographics and behaviors of single and multi-tenant constituents to validate business cases and opportunities.

Evidence of Previous Experience in the Connected Home and IoT Space (13.3, 14.3, 14.5)

Harbor Research's recent relevant experience in the connected homes arena and IoT market includes more than fifteen engagements over the last 38 months, including the following illustrative examples:

Demographic Analysis and Market Sizing on Emerging Connected Home Technologies

- **Client: Social Media Company**

For the largest social media and networking company in the US, we conducted a demographic research study and market sizing on a consumer device which includes emerging technologies like smart televisions, in-home media systems, virtual and augmented reality to understand the use cases, applications and user profiles in support of product and market development roadmap.

Connected Home Developer Survey on Smart Home Hubs

- **Client: Tier-1 Semiconductor Supplier***

Conducted primary research across 300 connected home developers to identify the required software and hardware features such as AI, voice assistants, and sensors of a forthcoming connected home hardware development kit. Additionally, the survey identified key connected home developer buyer profiles to determine the size, use cases, and value proposition of the hardware development kit to the developer and the developer's organization.

Analysis of IoT Data Management and Analytics Opportunity for Smart Buildings and the Connected Home

- **Client: Emerging Smart Building Platform and Analytics Supplier**

Analyzed current IoT data management and analytics solutions in the market, designed future requirements for information architectures in a distributed, peer-to-peer environment. This work was supported by conducting research to understand the convergence of IT and OT applications and challenges as well as the requirements for end-to-end software architectures that can address these opportunities by aggregating, mining, and analyzing data generated from the diverse set of sensors, equipment, and machines in buildings and homes.

*See Appendix B for research examples

Other example clients and engagements our team has worked on include (see Appendix E):

- **ARM** – *Future Mobile/Consumer Security Requirements Analysis*
- **Revolv** – *Review of Product Plans for Connected Home Automation Offering*
- **Tendril Networks** – *Analysis of Energy and Related Services for Home and Consumer Markets*
- **Honeywell** – *Building and Residential Control Components – Security Systems Innovation*
- **Eaton Electrical and Residential** – *Development of Home Automation System and Market Analysis for Residential and Light Commercial Opportunities for Network Services*
- **Schneider Electric** – *Building Management – Energy Management Opportunities*
- **Cisco Systems** – *Connected Consumer and Connected Real Estate Opportunity Analysis and Technology Roadmap for Security Services for Consumer and Commercial Applications*
- **Bosch** – *Corporate Planning – Residential and Commercial Security Systems Opportunity Analysis*
- **Pacific Controls** – *Connected Buildings, OEMs and Mobile Professional Opportunity Analysis*
- **Lightsource Energy** – *Residential and Commercial Rooftop Solar Energy and Monitoring Services Analysis*
- **Ayla Networks** – *Analysis of Drivers, Barriers to Adoption, and Interoperability in the Smart Home*

Summary of Harbor Research Project Approach (13.4, 13.5, 14.1)

Current State of Connected Homes

Smart Systems in connected homes provide a distributed control and information system that enables the control and digital experience of a home environment. It is comprised of a network of intelligent devices placed throughout the home that control or augment various functions, all with the intention of making the occupants more comfortable, safe, and efficient while at home. Our use of the term “Smart Systems” is analogous to what is commonly referred to as the IoT. The two terms are often used interchangeably, but within our research there is a distinction, and it is one that reflects the key changes affecting the market: our use of the term Smart Systems in a connected home context encompasses a broader set of control and information devices, enablers, tools and systems, including ‘home hubs’ or ‘connected home platforms’.

The market for connected home technology is fragmented and chaotic, with many technology suppliers bringing increasingly-complicated portfolios of connected home products to market that have inundated consumers with countless choices. Additionally, the user experience of connected home products continues to become more natural and satisfying, with enabling technologies such as smart lighting systems, in-home entertainment, home hubs and HVAC systems underpinning the futuristic and value-rich connected home solutions that is driving demand for connected home solutions.

Amidst the market mayhem, home owners and renters are seeking interoperable, easy to use and cost-effective means for better coordination of the systems in their home. They are turning to smart speakers and home hubs to help manage and process the data from the home’s disparate devices while linking them all together through seamless system-wide decision-making aided by Artificial Intelligence. While connected home solutions are varied in home occupants’ use based on lifestyles and behaviors, these key enablers of comfort, convenience and cost-savings will continue to play a pivotal role in the future roadmap of the smart home.

While there are multitudes of competing smart products for the home, players like Amazon Alexa and Google Home have accelerated the smart home road by continuing to move into adjacent areas within the home. Moreover, the vast ecosystems of developers and companies building products and services for Alexa and Google’s Voice and AI assistants are continuing to set them apart from other connected home companies. However, smart televisions, HVAC, and lighting systems are also driving adoption as the cost and simplicity to deploy these solutions decreases over time. The roadmap for connected homes in the future will be driven the combination of value-add to consumers crossed with the integration of services that drive new applications and use cases.

The desire for simplicity, convenience, and safety by home occupants continue to underpin the connected home roadmap, though the next phase will be accelerated by a new set of data services enabled by software and services (i.e. artificial intelligence). As companies continue to vie for attention from would-be connected home buyers, the differentiating factor and trade-off between brands and products will increasingly come down to the superiority of the devices and interoperability features of the connected home product or service.

Research Questions to Be Answered

State of the Market: Forces and Trends

- What are the core IoT applications being adopted today in connected homes? (safety and security, comfort and convenience, etc.)
- What is the diversity of devices being adopted in the connected home today? How will this evolve in the future?

- What are the requirements for interoperability across this diverse set of devices, including smart televisions, connected speakers, computers, home hubs, lighting systems, etc.?
- What is the current market position and direction of participants on open versus proprietary IoT systems and protocols? For connected homes, how do suppliers achieve interoperability of their connected devices? Which systems are converging within homes?
- What are the barriers to adoption and challenges that exist for IoT devices to become mainstream in connected homes?
- How does the interoperability of devices within the home relate to consumer preferences and use cases?
- How does cybersecurity and data privacy impact the adoption of connected devices? Will this have a direct impact on the adoption of these technologies in the next 3-5 years?
- How are data management and analytics tools supplementing or enhancing the value of devices in the connected home?
- What is the current and future roadmap of IoT technologies within the home? Are technology suppliers building the solutions that customers most want?
- What are the various potential future states of the smart home market, and which scenarios are most likely to play out in the development of the smart home market? How should market participants think about posturing themselves to address these various potential outcomes?

Customer Needs, Adoption and Buying Behaviors and Requirements

- Which IoT devices and applications are driving the bulk of interest and customer buy-in today? What is the consumer's perspective of the smart home market and its maturity?
- How do digital and IoT technologies impact home comfort, energy, and indoor air-quality? What is the role of these technologies in home entertainment and home security?
- For single and multi-family homes across demographic characteristics (e.g. age, income, gender, region), are there differences in technology adoption, buying behavior or system requirements?
- How do key stakeholders across the value chain view the digital and IoT roadmap in the connected home? How are digital and IoT projects funded and what will be required to increase adoption of these technologies? What regulations in North America are driving or inhibiting adoption of these technologies?
- What are the preferred user experience traits of digital and IoT solutions and products within the home (universal voice assistant, connected HVAC and lighting systems, physical security systems, etc.)?
- Who owns the data produced from these systems? What are the current views in the market place from key stakeholders on data management, ownership and privacy? What are the ethical and legal implications and how could this impact adoption?
- Which features and functions of connected home technologies will lead to adoption of these connected home systems, including virtual agents, home hubs, smart speakers, smart TVs, lighting and HVAC systems?

- What are the differences between usage behaviors and attitudes towards connected home applications among demographics of homeowners and renters?

Market Structure: Ecosystems, Use Cases and Connected Home Digital Roadmap

- Who are the key established players across each of the identified segments? (home owners and renters, technology manufacturers and suppliers, integrators and installers, service providers, industry associations)
- What is the device demographic market size and forecast for connected home devices and systems (lighting, physical security, home hubs, smart speakers, smart tv's, appliances, etc) in the connected home from 2018 – 2023?
- What are the attitudes of participants across the value chain with regards to IoT technologies (e.g. technology vendors, carriers, IT, OEMs, builders, insurance providers)?
- Who are the key innovators creating disruption in the connected home market? How are they differentiating themselves?
- What are the key partnerships that drive multiple vendor offerings? What companies are the leading single vendor offerings?
- Which ecosystem interactions are driving a convergence of technology from simple to more compound applications?
- What are the top applications and use cases driving adoption in the connected home today? What opportunities or use cases exist for further market growth in the future?
- What is the current state of adoption along the digital and IOT roadmap? What does the future connected home roadmap look like from a technology, customer and competitive standpoint?
- For each stakeholder group, what are the value propositions? What is the business case of IoT and digital opportunities for each of the player types? What are top case studies for each stakeholder group that prove the value of participation in the smart home?
- How should companies participating in the connected home space educate, position, and message products leveraging IoT and digital to educate dealers, distributors and users in target segments?

Proposed Project Methodology

The research and analysis work will examine the impact of connected home devices on the evolving connected home roadmap. As a result, the research and analysis will provide actionable insights and data as well as develop a business case that will identify barriers to adoption and will identify new revenue opportunities for organizations in the connected home value chain as well as potential entrants (home owners, technology manufacturers, application and software developers, integrators and installers and service providers). In addition, and where appropriate, we would plan to incorporate inputs from study sponsors and CABA constituents in the connected home market study.

Harbor would leverage heavy involvement senior staff members including Glen Allmendinger and Harry Pascarella. Harry would assist with both the primary and secondary research efforts from which user behavior and interactions with smart speaker and hub technologies would be surfaced. Glen would oversee the entire project, and provide specific insights on players, business models and other market dynamics by tapping into his IoT and consumer market experience and contact base.

To define and develop business opportunities within smart technologies as it relates to connected home, Harbor would undertake the following activities:

- Review and analyze existing applicable CABA and non-CABA industry research including past CABA research such as the Connected Home Energy Roadmap, Monetization Study and other relevant industry research.
- Review previous Harbor Research analysis of connected home, IoT platforms, voice recognition, artificial intelligence, smart lighting, HVAC and connected home devices. Leverage existing 2017 Connected home report research, and on-going research being conducted for the forthcoming 2018 Connected home report.
- Conduct interviews with CABA membership thought leaders as well as thought leaders in Harbor Research's community and network.
- Create a foundational framework for understanding the connected home roadmap and landscape from which the Steering Committee and Harbor Research can collaborate, including:
 - Trends and forces shaping connected home and connected device adoption amid evolving connected home requirements; convergence and interoperability of disparate devices within the connected home, including the emerging relationships between connected home devices such as entertainment systems and control hubs, as well as impacts on and evolution of standards bodies as they relate to data management, ownership and privacy;
 - Market map that analyzes the top opportunities in the context of applications, devices, and systems within the connected home market landscape. This will also include relevant application requirements with regards to services, platforms, data analytics, systems, and processes for home owners and technology suppliers;
 - Ecosystems of existing players (technology developers, network providers, speaker manufacturers, home hubs, etc.) and emerging players in the industry to identify roles in the value chain;
 - Digital and IoT enabled services and solution offerings within the connected home segment and relevant adjacent segments for home owners, service providers and technology manufacturers to identify current gaps and risks for connected homes;
 - Initial set of customer pain points (e.g. functionality vs. security), barriers and drivers to adoption to be validated or disproved by survey participants.

- Design a research process design to validate and analyze the proposed market concepts and hypotheses using surveys and in-depth interviews (Section 13.5, 14.1):

Market Survey

- Harbor will administer an online survey of market participants along with supplemental conversations, the survey will include **1500-2000** consumer tenants (rent and own, single and multi-tenant living quarters) distributed across agreed upon segments and demographics in the United States and Canada (this will allow us to establish a detailed data set and to provide a statistical summary and analysis of research findings). The survey will be designed in conjunction and cooperation with the CABA Connected Home Council Steering Committee. Harbor will plan to explore the use of a preference-based survey approach to understand tenants' priorities. An additional flat survey would address technology requirements, identification of buying behaviors, ranking of connected application needs, adoption hurdles/timing, and tenants' pain points.

In-Depth Expert Interviews

- Harbor will conduct parallel supplemental interviews (**approximately 30-40**) with marketplace stakeholders, including product manufacturers, service providers, software players, and IoT platform providers, as well as related specialist technology providers. Interviews will comprise of a mix of telephone and in-person interactions based on a discussion guide designed in cooperation with CABA. These interviews will work to understand how the requirements and use cases of users is shifting, and its impact on current roles and future opportunities in the value chain.
- Harbor will then employ a "Delphi-like" methodology/approach, based on above survey, to conduct a review of research results with a balanced cross-section of thought leaders and industry specialists/experts (approximately 15-20 people) to further validate results and provide a balanced coverage and perspective.
- Based on the above research and survey work, Harbor will conduct a business case analysis of the digital and IoT opportunity in connected homes to identify opportunities and challenges for all key industry players. This analysis will include:
 - Ranking of use cases for digital and IoT technologies in the connected home based on revenue and market growth opportunities;
 - Segmentation of consumers based on buying behaviors and lifestyles that determine the use cases for digital and IoT technologies;
 - Identification of digital and IoT solutions currently supplied by the market, and consumer preferences for the design, development, and delivery of future solutions and services;
 - Identification of ecosystem participants, and service delivery structures for most preferred solutions.
- The business case analysis will allow Harbor to articulate a clear set of recommendations for key industry players focused on specific opportunities, new business models and revenue streams.

- Harbor will develop a connected home roadmap that leverages the top use cases, devices and opportunities while identifying the technology, customer and competitive dynamics over the next 5-10 years for digital and IoT technologies in the connected home.
 - The connected home roadmap would leverage an in-depth scenario analysis to help identify which trends, opportunities, ecosystem partners and use cases are most likely to have an impact on adoption.
 - As a result, the roadmap would lay out three potential future states of the smart home market through the scenarios developed to help ecosystem participants develop context for indicators and anticipated challenges of growth.

Project Engagement Team (13.4, 14.3)

We bring to this project substantial industry experience, and a team with relevant expertise in connected product solutions for the Internet of Things. Senior staff will oversee and manage this research effort as well as participate in a focused and applied manner on the scope, design and conduct of this research program.

Glen Allmendinger - President and Founder

Allmendinger is the founder and president of Harbor Research, a strategy consulting firm with offices in Boulder, Colorado and Zurich, Switzerland. Since the firm's inception in 1983, Allmendinger has worked closely with a broad spectrum of telecommunications, information systems, electronics and automation and equipment manufacturing companies in North America, Europe, and the Far East. These companies range in scope from small, entrepreneurial start-ups to major multi-national corporations. His project direction and consulting has assisted these firms in the development of corporate and business unit strategies, new product, market and service opportunities, and new core capabilities.

Allmendinger has consulted to the National Research Council on technology and competitiveness as well as emerging technologies for social wellbeing. He is a member of IEEE, ASME, and ACM and has worked closely with several industry trade associations including CABA. He has worked on DARPA-funded research focused on advanced analytics and sensing systems technology and was a key participant in the planning and development of the National Center for Manufacturing Sciences. Allmendinger received his BA from New York University, and completed graduate studies at MIT's Center for Advanced Media Studies.

Harry Pascarella – Consultant/Project Manager

Harry is a consultant and project manager at Harbor. He specializes in Industrial IoT with a focus on manufacturing and natural resources markets. Harry works with clients across a variety of industries to validate and dimension their growth strategies and advise on industry segment and application target selections. Recently, Harry conducted several studies in smart buildings including a deep dive into energy management as well as a market study on the larger market that looked at usage behavior. Harry also worked with the largest LED lighting manufacturer in the United States to develop a business case for connected lighting platforms. Harry received his bachelor's degree in Economics from the University of Colorado – Boulder.



Derrick Burnett – Senior Associate

Derrick is a senior associate at Harbor, where he assists in developing research and content in support of client engagements. Derrick has experience in helping a large silicon manufacturer determine the routes and channels to market for smart home development kits that included comprehensive survey and in depth interview due diligence. Derrick has broad experience in industrial and transportation markets, working with automotive, industrial equipment, infrastructure, marine, rail, and aerospace clients to develop new business models, explore adjacent markets, and exploit new Smart Systems opportunities. Prior to joining Harbor, Derrick was an analyst for Accenture Strategy in Boston, and received his bachelor’s degree in Finance and Management from New York University’s Stern Business School.

Nicolas Jeambon – Senior Associate

Nick is a senior associate at Harbor, specializing in data-driven business models and focusing on how new data from diverse real world systems and devices are shifting business models and customer behaviors. Nick has strong experience conducting research and analysis on embedded networked systems, sensing, low power networking, and other Internet of Things architectures. He has contributed in publishing reports on the impact of IoT across buildings, connected home, energy, and industrial automation. Most recently, Nick worked with a leading software provider to evaluate the connected home and buildings space. The study examined value chains in the subsequent markets around buildings including HVAC, life safety, lighting and other equipment. Nick received his bachelor’s degree in Business at the University of Colorado – Boulder.

Harbor Research Profile (14.4)

An internationally recognized research, technology, and business development consulting firm, Harbor Research has predicted, tracked, and driven the development of the Internet of Things since our inception in 1984. While our history is long, our strategy is simple: capture and create value by combining accurate data discovery and analysis with creative systems-thinking. It is this mindset that has given us the privilege of working with some of the greatest companies in the world. Today, we continue to work with C-level executives and top management of some of the world’s most consistently successful companies and innovative startups. In the same way that the market has flexed and grown over the years, our services and experience have grown to make us the premier service organization you see today. We work with clients in a variety of ways including consulting, advisory, research and content development, thought leadership and workshop facilitation.

Project Timetable, Including Interim and Final Stages (13.6, 14.6)

Activity	Anticipated Date
Research Setup and Kick-Off	July 2018
Secondary Research	August – September 2018
Primary Research	August – October 2018
Analysis and Reviews	October 2018
Draft Report and Delivery	November 2018
Final report and Delivery	November 2018
Key Insights Identification Using CABA's Marketing Insights Management System (MIMS) Software	December 2018
Final Webinar (1.5 – 2 hours) With All The Sponsors to Highlight the Findings of the Research	December 2018
Individual Steering Committee Member Webinars (1 hour each), one (1) Webinar for Each Organization on the Steering Committee.	December 2018
Public Webinar (1 hour) to all CABA contacts to present the high level executive summary findings	April 2019

