CABA™

Connected Multi-Dwelling Units and the Internet of Things

LANDMARK RESEARCH PROJECT

EXECUTIVE SUMMARY

CABA AND THE FOLLOWING CABA MEMBERS FUNDED THIS RESEARCH:

SILVER

American Family Insurance · BC Hydro Power smart · Belimo · enercare · hydro one

Hydro Québec · Intermatic · Leviton · Pella · Schneider Electric

Siemens Ingenuity for life · Southern California Edison An Edison International Company · Southwire · TELUS

BRONZE

Alarm.com · Panasonic · Van Denburgh Consulting Group

CABA™ Continental Automated Buildings Association

Connect to what's next™

DISCLAIMER

Connected Multi-Dwelling Units and Internet of Things

This report was prepared for CABA by Harbor Research

Harbor Research

Acknowledgements

Harbor Research and CABA would like to acknowledge and sincerely thank the following CABA members for funding, guiding and participating in this research:

American Family Insurance
Daniel Berger
Tobin Jansenberger
Eric Orthey
Ryan Rist
Lee Shanahan

BC Hydro
Timothy Mosley
David Rogers

BELIMO Automation AG
Dennis Johannesen

Enercare Connections Inc.
Sarah Hung
Drazen Lucic
Ankush Randhaw

Hydro One Networks Inc.
Tom Semler

Hydro-Québec
Michaël Fournier
Marie-Andrée Leduc
Jocelyn Millette

Intermatic Inc.
Barbara Farrah
Liz Jacobs
Alex Mauritz

Leviton Manufacturing Co., Inc.
Bob Becker
Talia Salvador
Jay Sherman

Panasonic
Russell Pope

Pella Corporation
Larry Ehlinger

Schneider Electric
Prashanthi Sydhakar

Siemens Industry, Inc.
Douglas Anderson
Raphael Imhof

Southern California Edison Company
Jerine Ahmed

Southwire Company, LLC
Juan Galindo
Roy Jackson
Andy Pluister
Dave Watson

TELUS
Zouheir Mansourati

Van Denburgh Consulting Group
Elizabeth Van Denburgh

TABLE OF CONTENTS

FIGURES

EXECUTIVE SUMMARY

ES.1 RESEARCH BACKGROUND & INTRODUCTION

This executive summary presents key findings from the Continental Automated Buildings Association's (CABA) "Connected Multi-Dwelling Units and the Internet of Things" Landmark Study conducted by Harbor Research. The report summarized in this executive summary is based on a survey and interviews of 1,500 stakeholders, including developers, owners, operators and property managers, residents, technology providers, original equipment manufacturers, and service providers associated with multi-dwelling units across Canada and the United States.

Harbor Research and CABA would like to acknowledge and sincerely thank the following organizations for funding, guiding and participating in this research:

Figure ES.1 Landmark Study Funders

Role of the Steering Committee

This report the was prepared by Harbor Research for CABA's Connected Home Council (CHC). The two councils within CABA, the Connected Home Council (CHC) and the Intelligent Buildings Council (IBC) focus on expanding connected technology in residential and larger commercial buildings, respectively. Each council produces one collaborative "Landmark Research" project per year which is fully funded by CABA members.

Each Landmark Research project is directed by a Steering Committee made up of the project funders. The Steering Committee provides feedback and input throughout the course of the research to help define the scope, direction, and methodology. CABA and the project's Steering Committee commission a research firm to conduct the research while CABA provides project management and leadership.

Figure ES.2 Connected Multi-Dwelling Units and the Internet of Things Steering Committee Members

The connected home market is a fast-evolving industry segment that is being influenced by a number of emerging industry trends and pressing "hot button" issues. The CHC participated in several research ideation sessions to generate themes and select this CHC Landmark Research project topic. Of the many excellent ideas generated, the top three topics were voted on by CABA members and "Connected Multi-Dwelling Units and the Internet of Things" was selected. Having selected the topic, CABA released a Request for Proposal (RFP) and, after narrowing applicants down to two finalists, commissioned Harbor Research to conduct the research.

About CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, composed of over 360+ major private and public technology organizations dedicated to the advancement of connected home and building technologies. These organizations include private firms involved in the design, manufacture, installation and retailing of products, as well as public utilities and governments responsible for regulations and incentives that affect home and building automation. CABA is a leader in developing collaborative research across buildings stakeholder types and encourages the development of standards that accelerate market development.
Please visit http://www.caba.org for more information.

About Harbor Research

Founded in 1984, Harbor Research Inc. has more than 25 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. The firm has established a unique competence in developing business models and strategy for Smart Systems and the Internet of Things.

Harbor Research works with leading technology innovators and developers, product manufacturers and service providers. The firm brings together a unique combination of domain knowledge, facilitation processes and an extended community of partners and expertise that enables our clients to discover, design and develop smart systems and services.
Please visit http://harborresearch.com for more information.

Research Goals

The goal of this research is to examine in depth the impact of "Internet of Things" (IoT) technologies and the services that they will enable in the multi-dwelling unit (MDU) buildings market segment. This report will provide actionable insights and data as well as develop business cases that will identify barriers to adoption, and will identify new revenue opportunities for organizations in the MDU value chain, as well as potential entrants. This research examined the opportunities provided by IoT for MDU

stakeholders, including: building occupants, owner/operators and property managers, builders and developers, integrators and installers, technology manufacturers, equipment manufacturers, and service providers, including insurance companies, net service providers and utility companies.

To meet these goals, a detailed analysis concerning the future state of the MDU marketplace was conducted, encompassing the identification and evaluation of key trends, buying behaviors, technology challenges and opportunities. Case studies of IoT technologies and applications that highlight current adoption patterns in the MDU marketplace have been identified and the innovative players driving successful solutions highlighted. Top applications for IoT technologies in MDUs have been examined in business cases, examining the technical makeup of solutions and value proposition to various market participants. Within each business case, go-to-market/channel requirements were developed to highlight the role of different stakeholder types in these solutions and recommendations were made for how firms should organize to capture new value from smart, connected offerings.

Research Methods

The methodology for defining, identifying, and analyzing IoT technical and business opportunities followed the procedure below:

Review Existing MDU and IoT Research: Review and analyze existing CABA and Harbor industry research on connected home, IoT technologies, building management systems and the MDU market.

Conduct Secondary Market Research: Conduct supplementary secondary research to identify additional relevant trends, market forces, new building systems technologies and players.

Conduct Interviews with Thought Leaders: Identify and organize a list of key stakeholders and conduct interviews with industry thought leaders and steering committee members.

Develop A Framework to Identify Opportunities: Develop a market application map that identifies key requirements, business opportunities and enabling technologies/key technical requirements.

Identify Pain Points, Opportunities and Current Solutions: Develop an initial set of customer use cases, pain points and barriers to adoption to be validated or disproved by survey participants.

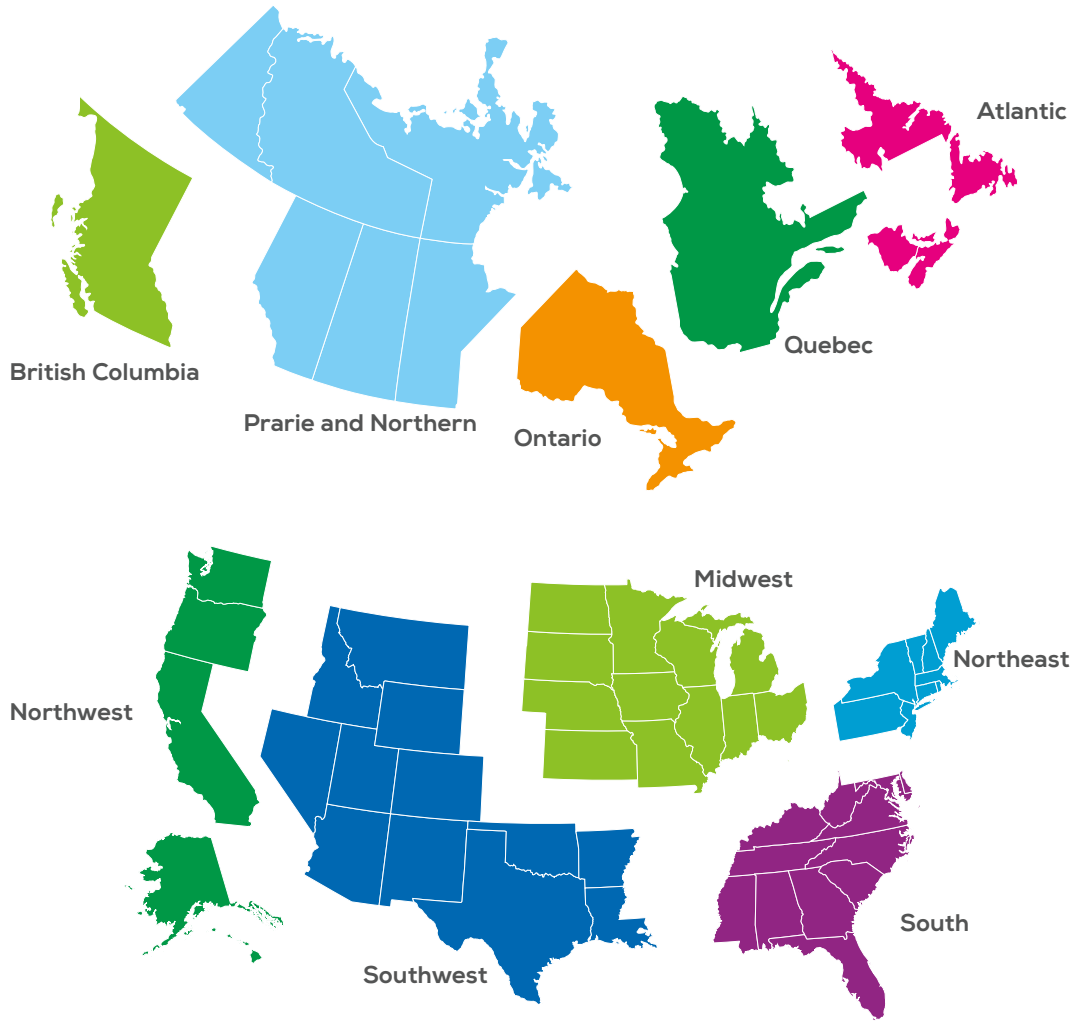
Having identified and framed the opportunities via the above detailed process, parallel quantitative and qualitative primary analysis was conducted alongside supplementary market research and analysis. A market survey was developed and administered across 1,500 respondents representing all identified stakeholder segments from the United States and Canada. For the purposes of this research, the United States was segmented into five regions:

- "Northeast", including CT, ME, MA, NH, RI, VT, NJ, NY, and PA;
- "Midwest", including IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD;
- "South", including DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, and TE;
- "Southwest", including AR, LS, OK, TX, AZ, CO, ID, MT, NV, NM, UT, and WY; and
- "Northwest", including CA, OR, WA, AK and HI.

Canada has been similarly divided into five regions:

- British Columbia;
- "Prairie and Northern", including MB, SK, AB, YT, NT, and NU;
- Ontario;
- Quebec; and
- "Atlantic", including NB, NS, PE, and NL.

Figure ES.3 Regional Breakdown of Canada & United States



The results of this survey were utilized to identify the current state of the market from an adoption standpoint, uncover the most prevalent technical barriers, adoption challenges and opportunities, reveal which IoT applications are driving the most adoption today, and learn about each stakeholder groups' view on needs and requirements such as analytics, physical security and data privacy and ownership.

This research included direct interviews with over 50 MDU participants to understand their role in the spec and decision-making process for IoT technologies, preferences based on usage or tenant demographics, retrofit vs. new build approaches, knowledge of tools available for analytics, energy efficiency and remote monitoring. Additional interviews with recognized thought leaders, experts, industry associations and other sources were then conducted to verify, balance coverage and test findings in a Delphi-style approach.

In addition, this research leveraged previous work that Harbor and CABA have independently performed to identify key trends, players, IoT application evolution and requirements for IoT platform architecture for connected MDUs. Case studies from real-world implementations were developed to address market direction and provide quantitative opportunity sizing for the identified applications.

Report Structure

Chapter One provides context for the development of Smart Systems in MDUs by examining the trends and forces driving the development of Smart Systems and the adoption of IoT technology across a range of markets. Chapter Two then explores the opportunities for Smart Systems across the Buildings Venue, with the key trends and forces driving development of offerings in the Commercial and Single-Family Residential venues examined.

Chapter Three begins our examination into the MDU market, including how to frame opportunities based on building structure, property manager types, and occupant personas. Trends and forces shaping development and adoption of connected devices and services in this market are examined across technology, competitor, customer, and socioeconomic realms. Here we also highlight the underlying elements common to all IoT solutions and point to the overall scale of Smart Systems opportunities within the MDU market.

Having set up the opportunity in MDUs, Chapter Four then investigates the business case for the largest Smart Systems applications. These are broken down by stakeholders involved, trends and forces affecting the application, identified success factors, and case studies of real world implementations. Channels to market, conclusions and implications for various stakeholders involved in the application, and recommendations by stakeholder type are presented.

Chapter Five concludes the report with key opportunities for various types of equipment manufacturers and service providers to target, technological and strategy success factors, and future implications of current developments for which suppliers must begin preparing.

ES.2 SUMMARY OF KEY FINDINGS

The Internet of Things in Smart Systems - Chapter 1

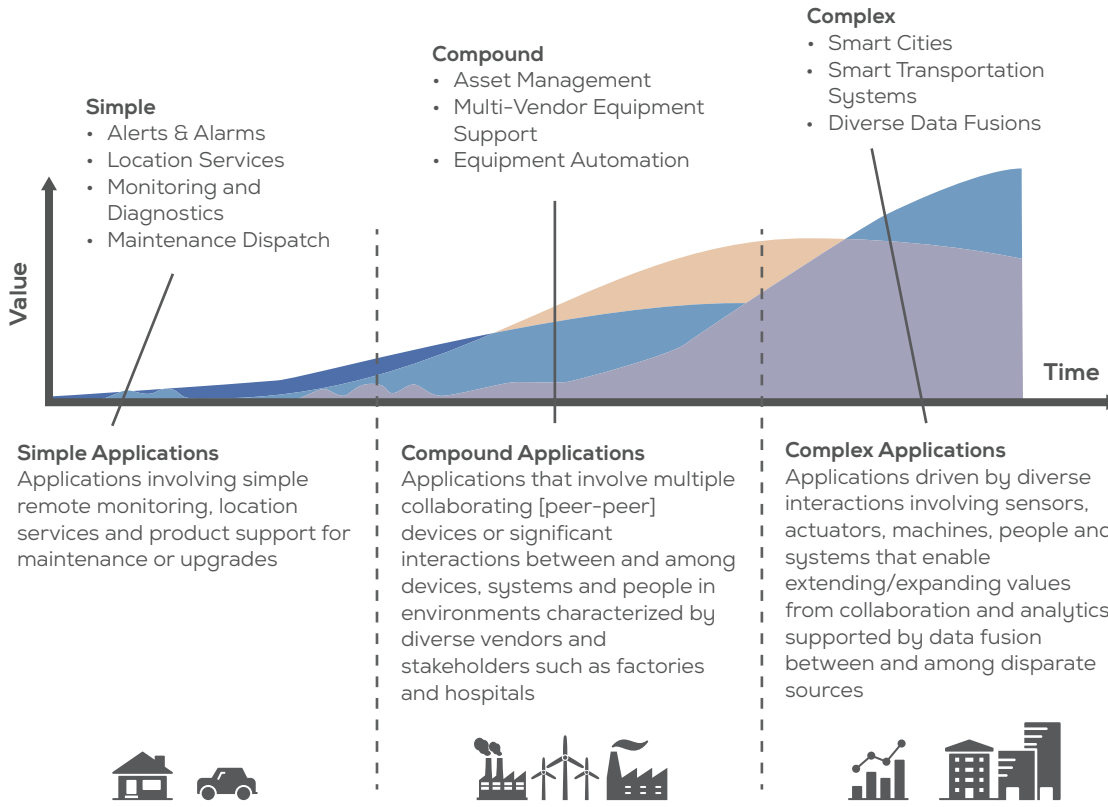
For quite a few years now, much research and consulting has been conducted to understand the impact of the convergence of embedded computing with the packet-switching "network of networks" called the Internet. These days, many people refer to this technological evolution as the "Internet of Things" (IoT) or "M2M," which usually stands for "machine-to-machine." A more accurate and encompassing term for these networks is "Smart Systems," because it begins to capture the profound enormity of the phenomenon, something much greater in scope than just machine connectivity.

Whatever we choose to call it – "Smart Systems" or "Pervasive Computing" or the "Internet of Things" – we are referring to digital microprocessors and sensors embedded in everyday objects relaying information over agile global networks. These networks could comfortably scale to trillions of nodes - some of them hardware, some software, some purely data, many of them coming into and out of existence or changing location constantly.

Increasing analytic capabilities, combined with connectivity, data storage, and processing advances are enabling use cases to become more complex, creating more value for a wider variety of stakeholders. Smart Systems have traditionally focused on "simple" applications involving a single device used in monitoring and alerting cases. Interoperability and increasing capabilities are enabling "compound" applications, in which a simple application is coordinated with other such apps, sharing data and orchestrating device actions. "Complex" applications, which drive interactions across many devices, systems and people, are no longer predominantly held back by technology, but rather by business models. Without the structures in place to develop and capture value from multi-vendor solutions, these applications will remain elusive.

Smart Systems that connect people, devices, business processes, and content to enable collective awareness will drive a multi-year wave of growth based on the convergence of the virtual and physical worlds. The Internet of Interactions, between and among "things" and "people," requires much more than simple incremental improvements in today's technologies to be fully realized. The challenge is much more than a simple patch, Band-Aid, or new flavor of what we already do.

Figure ES.4 The Value of Smart Systems in Increasingly Complex Applications



What's required is a true shift in thinking about how devices, people and physical systems will be integrated and how they will interact. We need an approach that is not about leveraging aging IT technology into a new application context; it's about looking forward to a single, unified architecture for the nearly infinite interactions to which any person or thing can contribute.

Innovations across the technology stack, from networking to applications, are enabling increasingly complex applications across many industries. Realizing this new mode of interaction requires shifting the focus from simple device monitoring to a model where device data is aggregated into increasingly complex applications to achieve true systems intelligence. It's a shift from knowing "what happened" to knowing "what is happening" all the time, with systems autonomously reacting to that knowledge to optimize their operations in real-time.

While some companies will always choose to stay with the status quo, leading product OEMs will vigorously embrace the power that lies within self-initiated communities. Though their business models are intermingling today, all the major categories of traditional solution suppliers have historically operated within well-established business models that reflected the distinctive competencies that each group believed to be at its core. The advent of Smart Systems is blurring these legacy business models and redrawing the competitive landscape, forcing major suppliers to re-think their strategies.

Smart Systems in Buildings - Chapter 2

Smart Building Systems provide a distributed control and information system that enables the control and maintenance of a building environment, leveraging a network of intelligent devices to monitor and control the mechanical and related systems in a building. In this context, our use of the term "Smart Systems" is analogous to what is commonly referred to as "building management systems" (BMSs). The two terms are often used interchangeably, but within this report there is a distinction, and it is one that

reflects the key changes affecting the market: our use of the term Smart Building Systems encompasses a broader set of control and information devices and systems.

Simply put, an intelligent building is a structure in which sensors, switches and systems contained within the building's infrastructure are networked and can communicate with each other and with a human operator through a monitoring or control interface. While this may seem relatively straight-forward, like most things, it is far more complex when put into practice.

A dominant trend in the Buildings Venue is the increased operator awareness of and interest in Smart Systems that provide greater asset visibility and management. Meanwhile, continued interest in energy management among building operators is driven by socioeconomic pressures as well as the availability of interoperable solutions arising from the proliferation of available networked products. These factors are driving operators to adopt solutions that prioritize overcoming integration and security issues.

This analysis highlights diverse challenges to firms seeking significant and sustainable success in offering Smart Systems across the Buildings Venue, including:

- Difficulty adopting new business models and justifying the business case within a fixed time horizon;
- Complex services and solution-delivery ecosystems that require businesses to relate in new and different ways;
- Anticipation of new product, service and systems innovation modes that are not widely adopted today;
- A fragmented IoT and Smart Systems vendor landscape that is not yet well aligned with the larger IT infrastructure and carrier players; and
- Requirements for vertically-focused solutions from a supply-side world that has historically been far more horizontally driven.

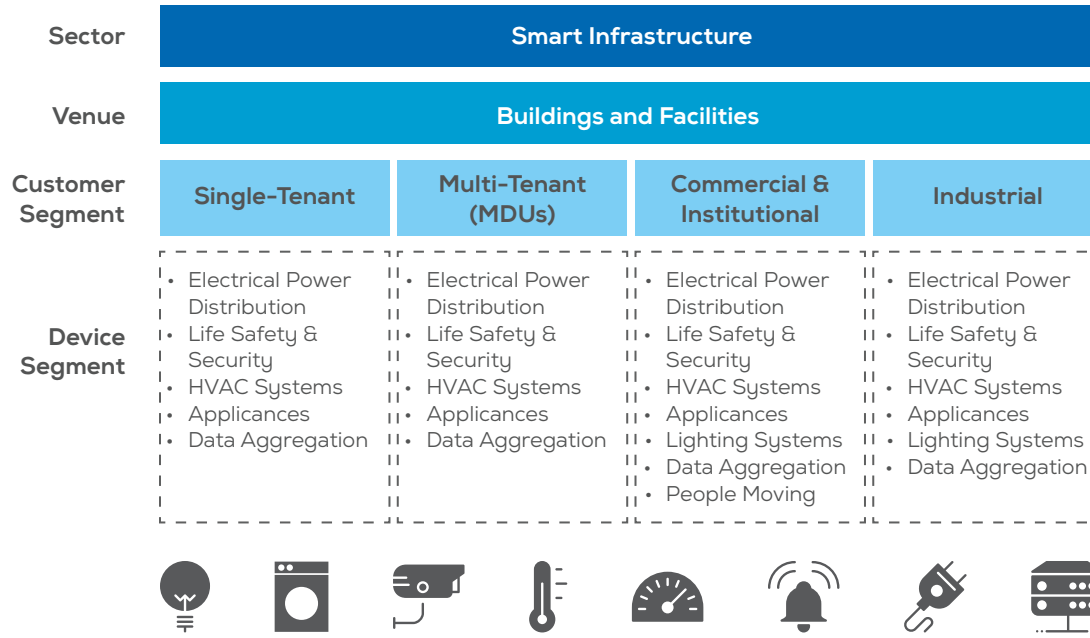
Buildings Venue Segmentation

The opportunities for the Internet of Things are segmented into five economic sectors that encompass eight distinct venues. Within the eight venues, there are 29 customer segments with over 400 distinct connected product segments that Harbor Research analyzes and forecasts. The Buildings Venue resides within the Smart Infrastructure sector and consists of systems that are either part of the building's internal systems (e.g., HVAC, lighting, electrical power distribution) or devices that are installed on or within buildings that are not meant to be moved regularly (e.g., appliances, security and life safety equipment).

The four customer segments within the Buildings Venue are organized in the following manner:

- Commercial and Institutional, including: big box retail, specialty retail, malls, office buildings and related commercial real estate;
- Industrial, including: factories, labs, distribution centers, etc.;
- Single-Tenant Residential Homes; and
- Multi-Tenant (MDU) Buildings, including: multiplexes, townhomes, low-rise, mid-rise, and high-rise condo or apartments.

Figure ES.5 Smart Buildings Market Map



This report focuses on the opportunities for Smart Systems in MDU buildings specifically, a market that has traditionally been served not by a dedicated set of suppliers but rather by those focused primarily either on commercial buildings or single family homes. The physical structures and centralized building systems of MDU buildings share characteristics with commercial buildings, as do the needs of building operators and property managers (which are interchangeable stakeholders for our intents and purposes) with regard to building and equipment management across these customer segments.[1] However, the presence of occupants means that individual units and common areas must operate more like single-family homes, prioritizing the comfort, convenience, and peace-of-mind of occupants. Suppliers coming from both angles, commercial and single-family, have failed to adequately meet the unique needs of this market.

Smart Systems in Multi-Dwelling Units - Chapter 3

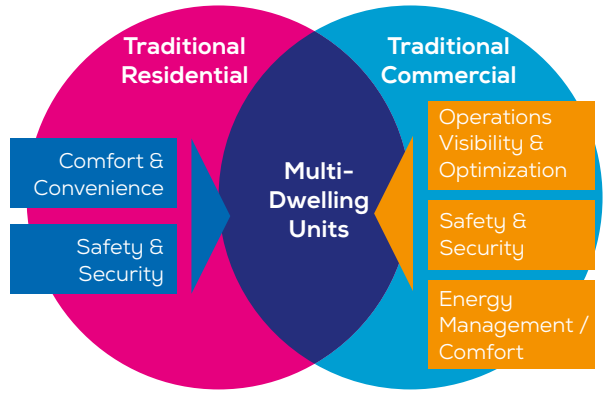
MDUs sit at the intersection of single-family homes and commercial buildings, sharing characteristics of each. Responsible for decision-making around central building offerings as well as installed devices within units, owners and operators (including third-party managers, owner/managers, and owner/occupants) have two unique needs which must be met to justify adoption of connected offerings. First, they must retain an appropriate level of service control, which does not impinge on occupant privacy but provides the ability for the manager to manage services during turnover and ensure that terms of the lease are maintained.[2] Second, they must realize an attractive ROI from connected offerings, which can be captured in several ways.

Operating margins can be increased by reducing ongoing expenses with the adoption of devices and services that increase the efficiency of building systems and management processes. Operating expenses are also decreased by reducing vacancy and occupant turnover, both of which can be accomplished with adoption of offerings that increase occupant satisfaction.[3] Such offerings also grow the top line by differentiating the property and enhancing customer acquisition in competitive markets.[4]

Figure ES.6 MDU Requirements Represent a Blend of Residential & Commercial Needs

Residential
Technology in residential settings has always focused on two applications: comfort & convenience and safety & security. As such, traditional suppliers have tended to target a specific application. While the line between the two groups of suppliers is blurring, these consumer-oriented companies are rarely geared towards commercial applications.

Due to the fragmented user-base and fickle nature of consumers, new entrants are coming from all angles and some are experiencing mild success as the race for consumer acceptance (and data) continues.



Multi-Dwelling Units
MDUs are characterized by two groups of stakeholders: occupants and owner/operators. The structures themselves are closer to commercial buildings in terms of size and more centralized systems, however, the needs of individual unit occupants must be considered.

Commercial
Technology in commercial buildings has traditionally focused on operations visibility and optimization and safety and security. These buildings are characterized by more centralized systems, and due to the size of these buildings, they incur high operations costs (e.g., energy, maintenance, etc.).

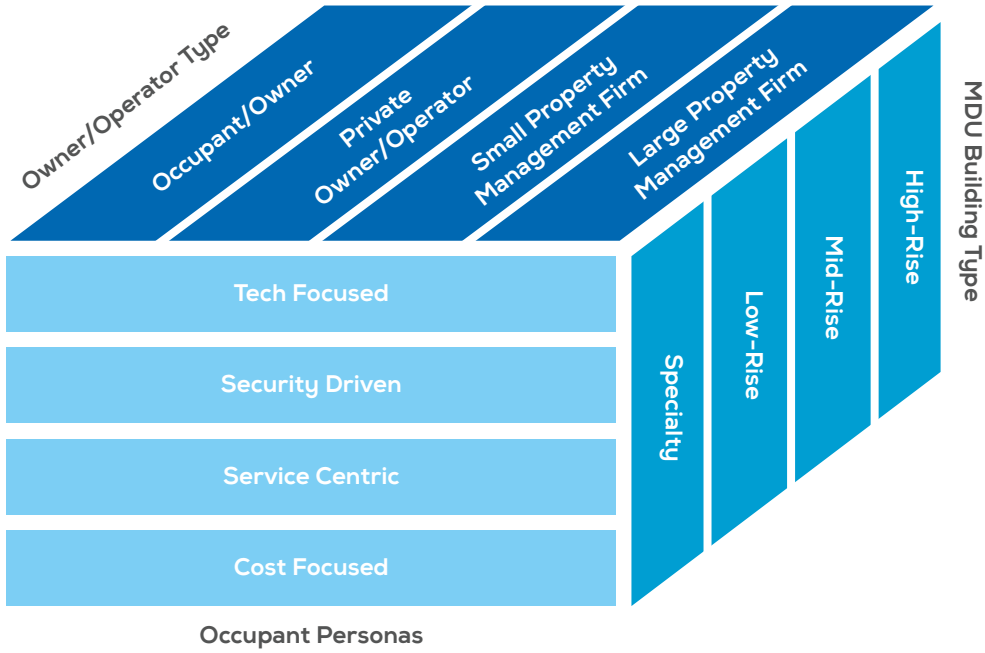
Larger IT companies and equipment manufacturers have controlled much of this market in the past. These traditional suppliers have acquired new software and application platforms to provide better services to their customers, and are entrenched in their market-leading positions.

The inability of both commercial and home automation players to organize successful offerings for this market has left the door open for agile startups to create solutions tailored to the unique needs of MDU building stakeholders.

Market Organizing Principles

The opportunities for IoT technology-enabled use cases in MDUs are shaped primarily by three factors: building structure, property manager persona, and occupant persona. Factors across these three dimensions combine in any and every manner, leading to a very complex and fragmented set of adoption characteristics. The combination of these factors for a given MDU determines which use cases are most desired, the technical capabilities of those use cases, the stakeholder who captures value from adoption, the stakeholder who makes decisions regarding adoption, and the suppliers who are best positioned to deliver solutions.

Figure ES.7 Framing the Smart Systems Opportunity in MDUs

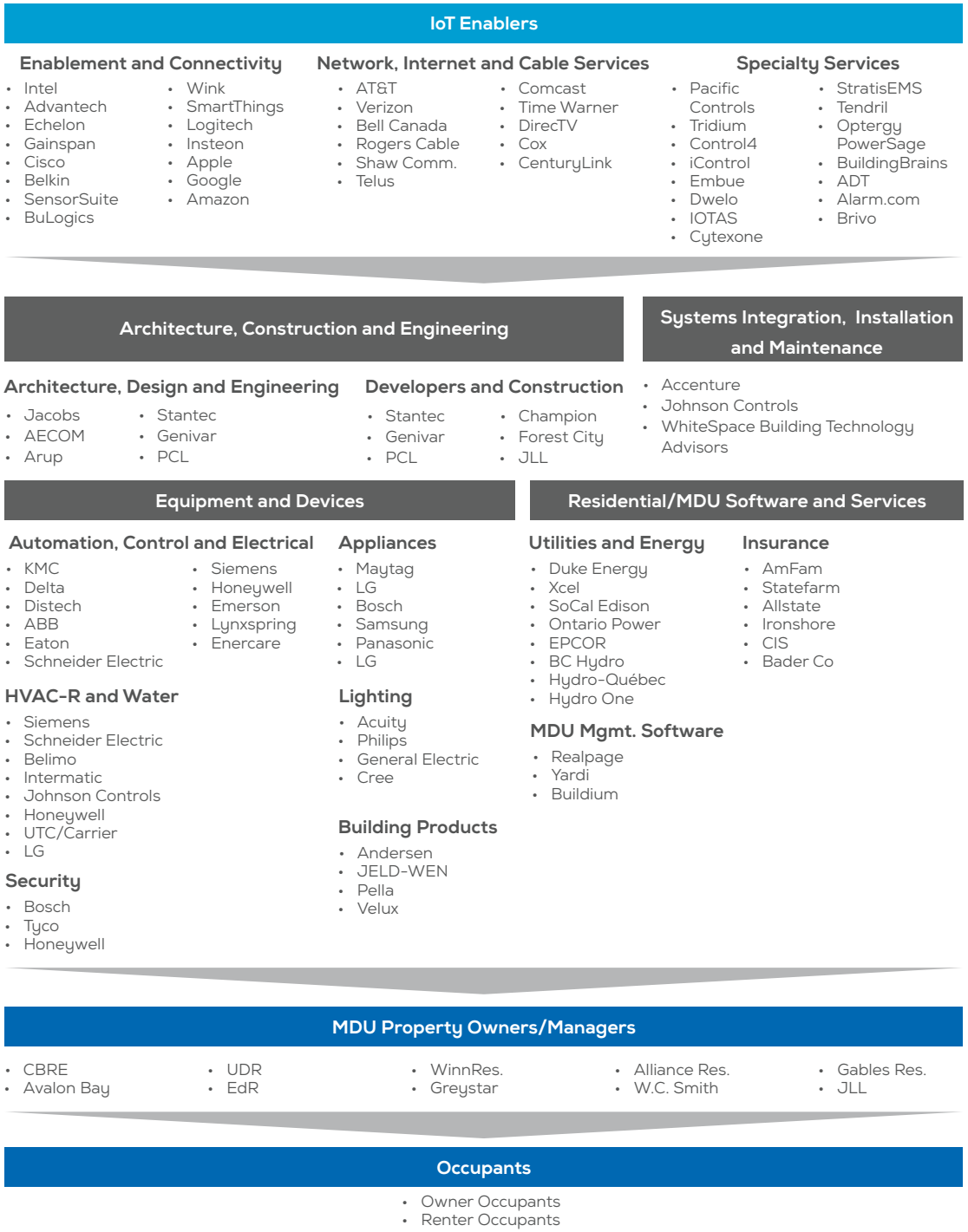


This complexity requires suppliers to have flexible offerings and delivery mechanisms in order to meet the needs of different MDU structures, manager types, and occupant personas. Traditional suppliers of building automation systems to commercial buildings have focused on scale rather than addressing the complexity posed by the three dimensions of MDU opportunities and the needs of particular structure/manager/occupant combinations. Further, our discussions with managers have indicated that the willingness-to-pay for automation solutions in MDUs is considerably smaller than that in commercial buildings, challenging the cost structure of traditional building automation suppliers.[5]

Meanwhile, smart home suppliers who have attempted to scale their offerings out of single family residential and into MDUs have been challenged by the requirement to meet the needs not only of building occupants but also of property managers. Our research confirms that consumer adoption of connected devices that they bring with them, including lightbulbs, speakers, TVs, cameras and motion detectors, is on the rise among tech focused occupants, enhancing in-unit comfort, convenience, and peace-of-mind. However, without coordination with devices and systems that unit owner/operators install, including thermostats, major appliances, HVAC-R equipment, air and water distribution systems, and the building network backbone itself, the ability to create value within the unit is limited.

IoT enablers have emerged to disrupt traditional building system providers by offering more technologically advanced, open solutions. These players are all over the market, working with OEMs, service providers, and even directly with end-users. Their sensors and hardware may be embedded into an OEM's products during the manufacturing process, or a systems integrator may be responsible for building a network that includes hardware from multiple enablement vendors. Sensing an untapped, growing market, specialty IoT platform and service providers have recently cropped up, targeting the MDU market specifically. Players such as IOTAS, Embue, Optergy, StratIS and Dwelo have taken the challenges of this market head on, and stand to benefit greatly from the inaction of traditional buildings suppliers.

Figure ES.8 MDU Competitive Structure



EXECUTIVE SUMMARY

Scale of Smart MDU Opportunity

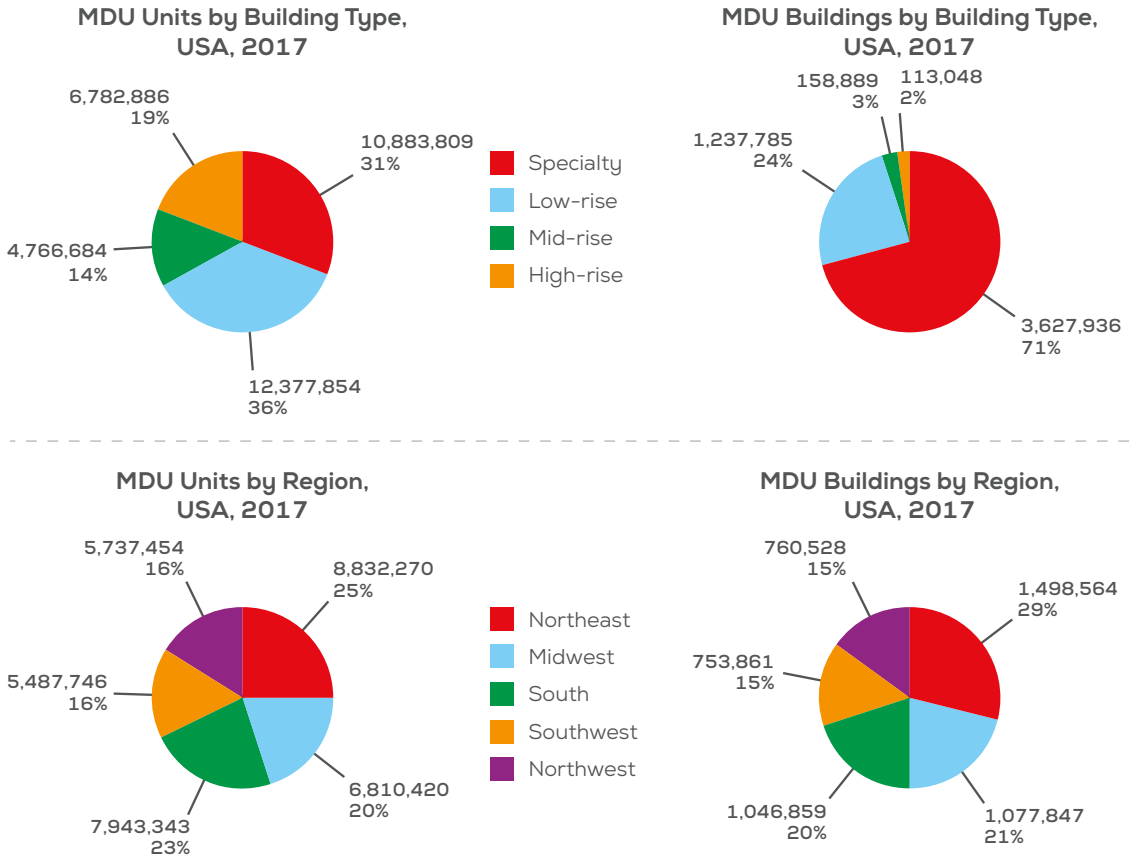
The margins per building may be small, but the addressable market is anything but, with greater than 6 million MDU buildings across the US and Canada housing over 40 million individual units.[6] Further, as the percentage of renters continues to increase, driven by the perceived risks of ownership following the 2008 recession and the flexibility and freedom desired by millennials, who make up the largest portion

of both renters and the general population,[7] connected offerings for rental units will be increasingly desirable.

Over 85 percent of all MDU units and buildings between Canada and the US are in the US, with the Northeast, South and Midwest regions all individually containing more units and buildings than all of Canada. In Canada, Ontario and Quebec account for over 68 percent of all units (3.9 million) and 66 percent of all MDU buildings (0.58 million)

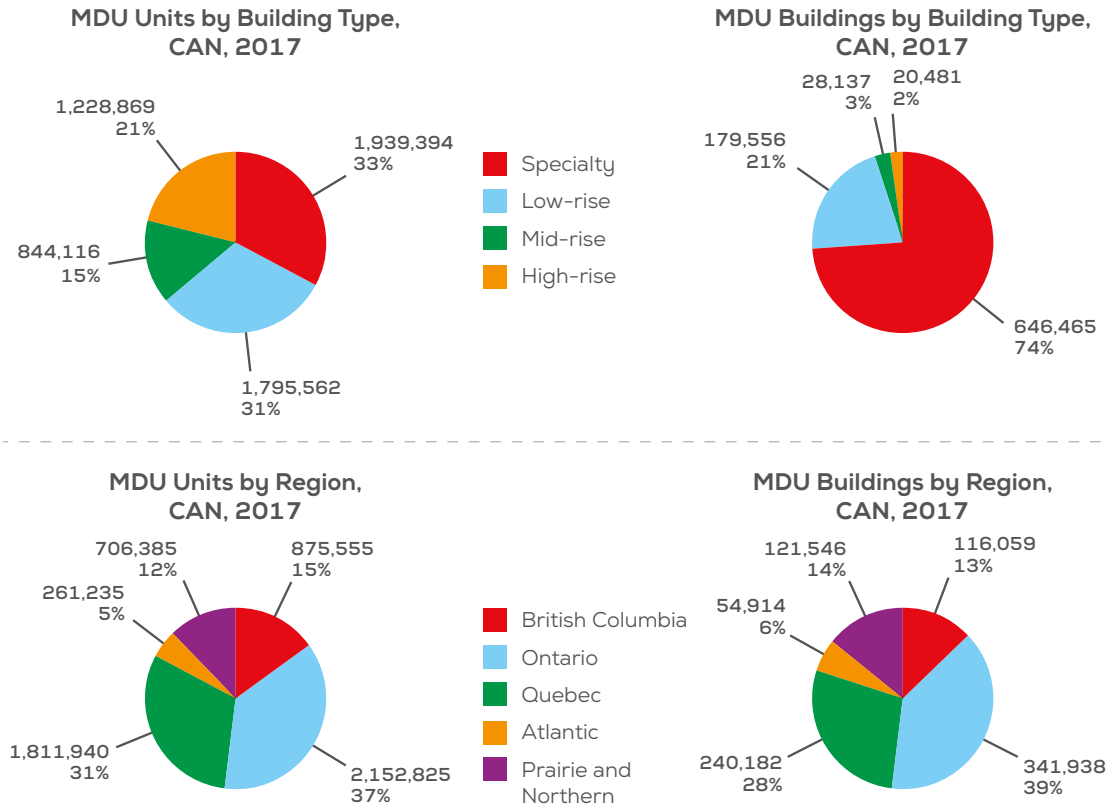
Over 70 percent of MDUs are specialty building types, but these buildings only contain about 32 percent of all MDU units. Low-rise units account for the greatest number of units at 14.1 million, or 34.9 percent of the total units in Canada and the United States. While high-rise buildings only represent 2.2 percent of all MDU buildings across these regions, they contain 19.7 percent of all units.

Figure ES.9 United States MDU Buildings & Units by Type and Region



Source: US Census Bureau, National Multifamily Housing Council, Harbor Research Analysis

Figure ES.10 Canadian MDU Buildings & Units by Type and Region



Source: StatCan, Harbor Research Analysis

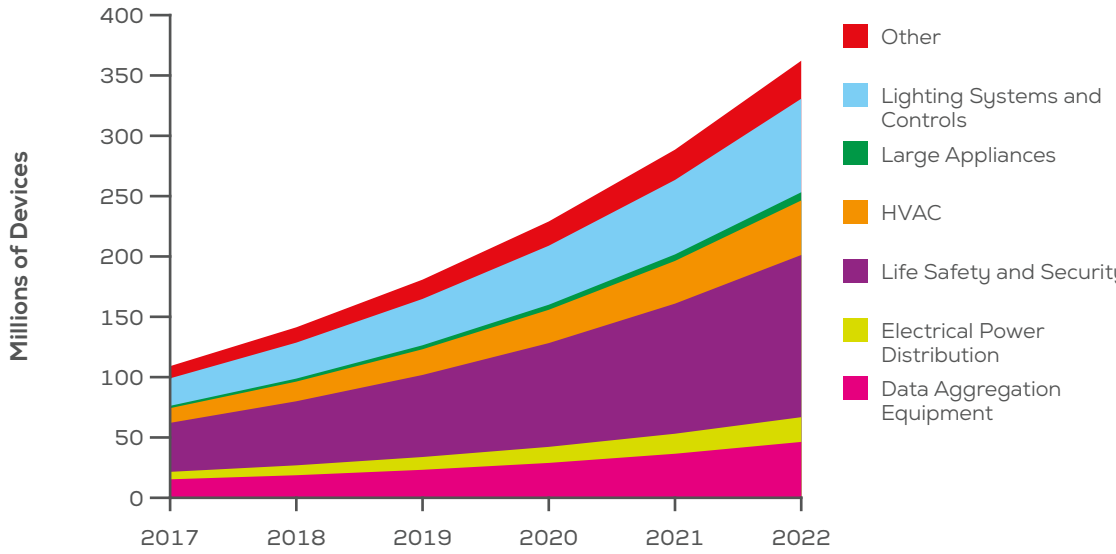
Smart Devices within MDUs

Across the forecasted device segments, there are over 92 million installed connected devices in the United States and over 16 million installed connected devices in Canada for a total of 109 million connected devices between the two countries in 2017. This installed base is forecasted to grow at a rate of 27.1 percent over the forecast period, resulting in 362 million installed devices in 2022.

There are over 36 million shipped connected devices in the United States and over six million shipped connected devices in Canada for a total of 42.5 million connected devices shipped in 2017. The number of shipped devices is forecasted to grow at a rate of 24.1 percent over the forecast period, resulting in 125 million devices shipped in 2022.

The largest device segment by number of devices installed is Life Safety & Security, with 40.6 million devices installed in 2017, growing at a rate of 27 percent over the forecast period resulting in 134 million devices installed in 2022.

Figure ES.11 Installed Devices by Device Segment, 2017-2022



The MDU market presents a significant opportunity for smart systems and IoT-based revenues, with a total opportunity of $2,908 million in 2017 growing at a compound annual growth rate of 31.6 percent to $11,488 million in 2022. Smart Systems revenues for MDUs break down into the following macro categories:

- **Enablement revenues**, the smallest revenue stream, represent an opportunity of $282 million in 2017.
- **Network services revenues** represent 20 percent of the total opportunity in 2017, with a value of $586 million and growing to $1,926 million in 2022 at a CAGR of 26.9 percent.
- **System applications revenues** are growing at a rate of 32.9 percent over the forecast period, increasing from a $420 million opportunity today to a $1,738 million opportunity in 2022.
- **Value added applications** represent the largest revenue opportunity at $1,620 million in 2017 growing at a CAGR of 35.1 percent to $7,278 million in 2022.

The value added application revenue stream is broken down into five applications within MDUs, all explored in-depth in the following sections. The largest of these applications is Building & Equipment Management, an operations-focused application targeted at building owners and operators. The opportunity for this application is $457 million today, growing at a CAGR of 35.9 percent to $2,119 million in 2022. More details on the opportunities around these applications can be found in the report body.

Figure ES.12 Smart Systems Revenues by Revenue Stream, 2017-2022

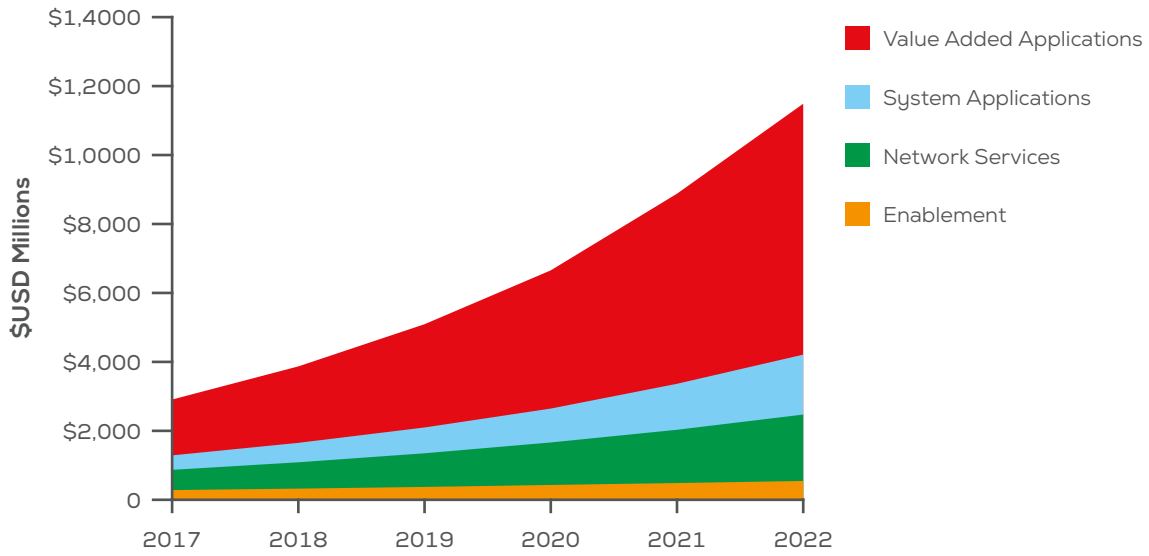
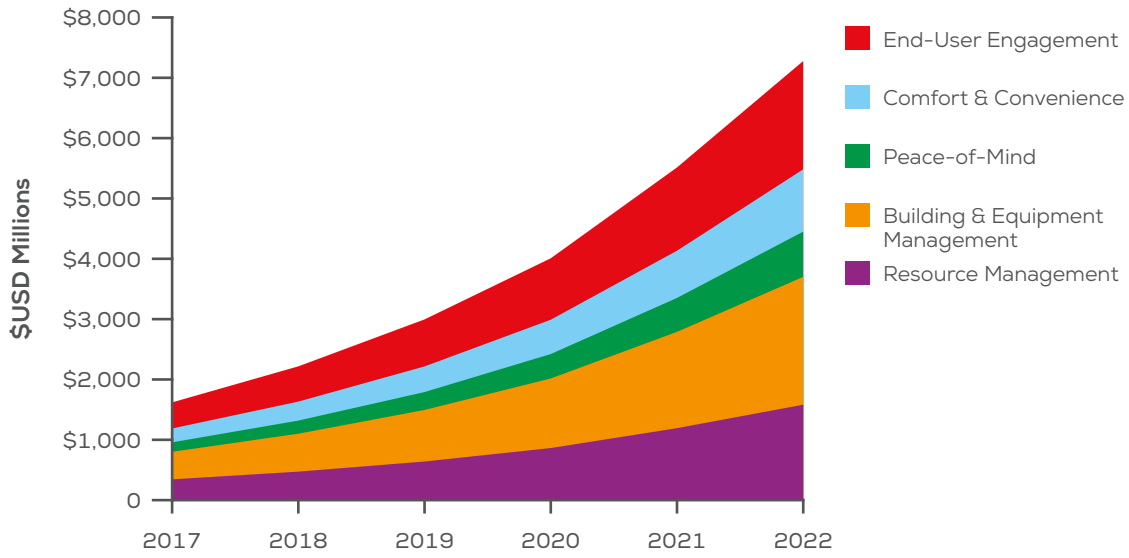


Figure ES.13 Value Added Application Revenue by Application, 2017-2022



Key Trends and Forces Affecting MDU Opportunities

Technical developments are leveraging IT functionality to enable new capabilities in OT applications, as increasingly powerful wireless tools enable new sensing opportunities and advanced data management tools allow value to be created from collected data with greater ease. Meanwhile, building operators and occupants, especially tech-focused millennials, expect interactions with building and unit systems to be intuitive where needed but generally minimized. Ideally, systems operate in the background of buildings, requiring limited user interaction to enhance peace-of-mind and comfort or maximize operational efficiency.

Recognizing the opportunity opened by the inability of incumbent Commercial and Single-Family Residential automation players to adequately serve the MDU market, specialists have begun to find

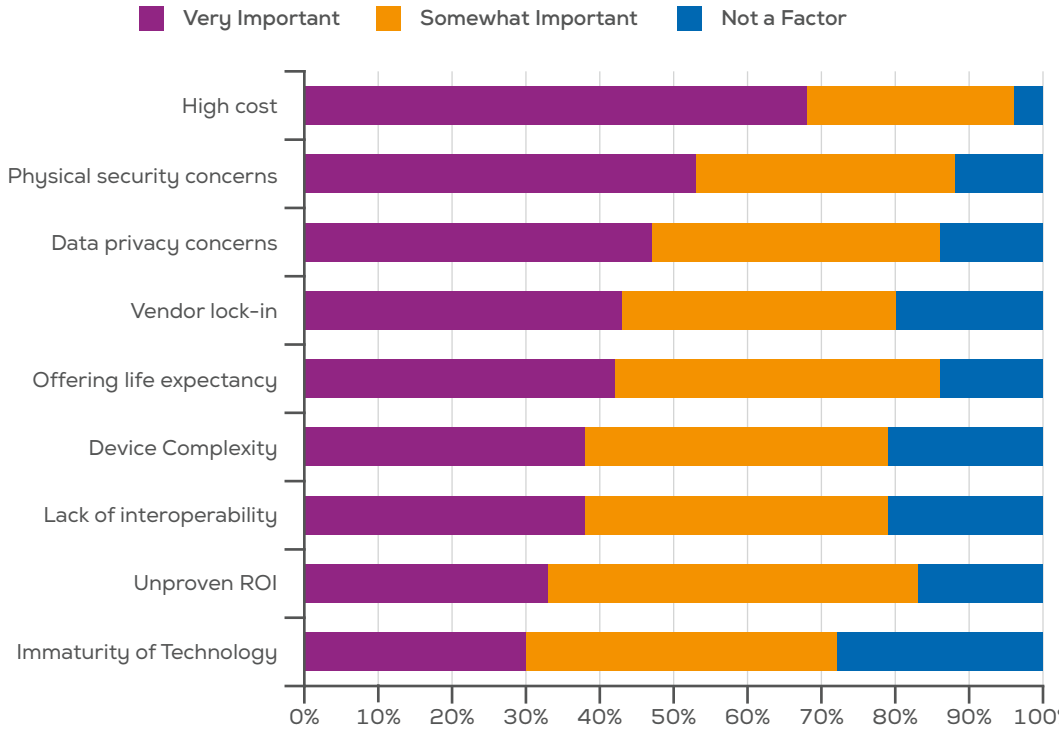
success with targeted offerings that bridge the "split incentive" challenge of serving occupants and building operators in this market. Comfort and convenience focused offerings are especially popular among tech-savvy, environmentally-conscious millennials who make up the largest portion of the renter population and are seeking housing in urban centers.[8]

This migration is creating competitive MDU markets as rates of new construction continue to recover from the stall precipitated by the 2008 economic downturn, encouraging operators to differentiate their buildings with connected offerings. Meanwhile, regulatory action and volatile energy prices have encouraged building operators to invest in management systems to increase energy consumption efficiency, thereby lowering operating costs and extending the life of equipment.

Drivers and Barriers of Offering Adoption

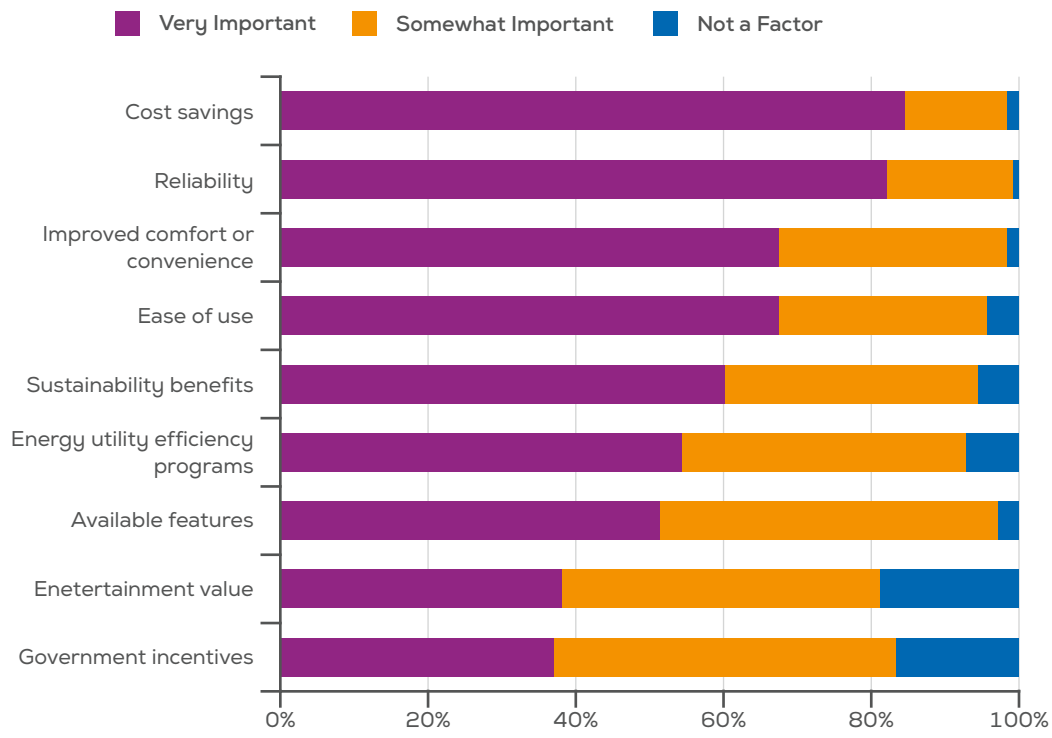
The high initial cost of connected offerings continues to be a primary impediment to device adoption, though high-profile device hacks and network breaches have elevated personal security and data privacy concerns. A promising sign to suppliers is the relatively low number of respondents who note a lack of belief in the benefits of connected offerings as a barrier to adoption.

Figure ES.14 Occupant Barriers to Adoption, n=809



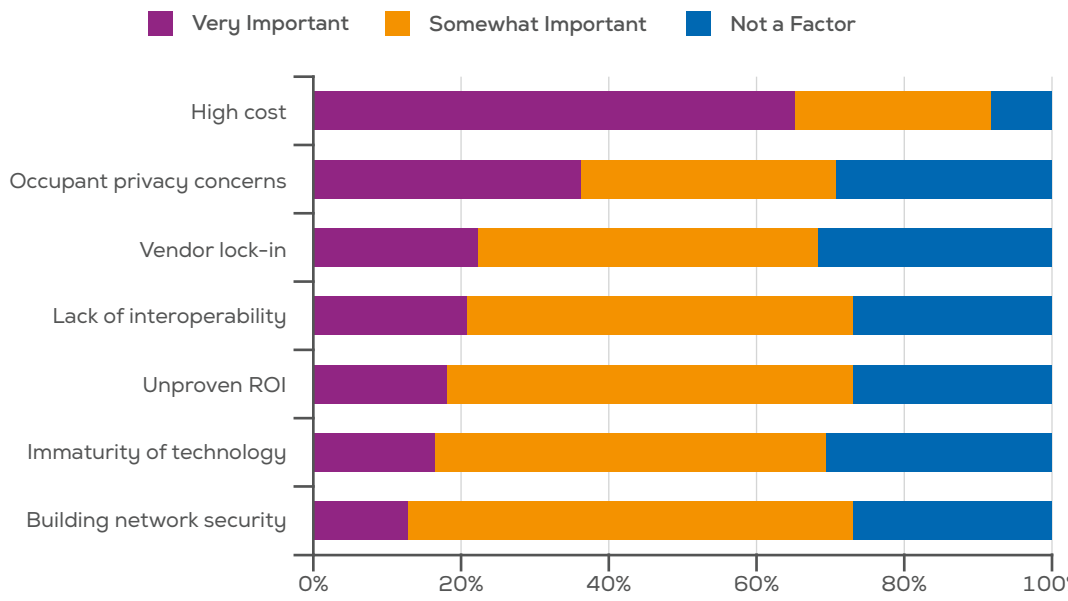
In terms of driving adoption, occupants rank cost savings, reliability, and improved satisfaction from connected offerings as their primary motivators, further emphasizing that those interested in these offerings are informed of their benefits. Aside from directly reducing utility expenses, implementations have highlighted that convenience-enhancing offerings generate indirect cost savings for end-users by reducing the cost of and time spent on maintaining their units.[9] This indicates that providers should focus on reaching a broader audience with messaging, and should increase awareness outside of the tech-fluent that these offerings have proven value.

Figure ES.15 Occupant Adoption Drivers, n=522



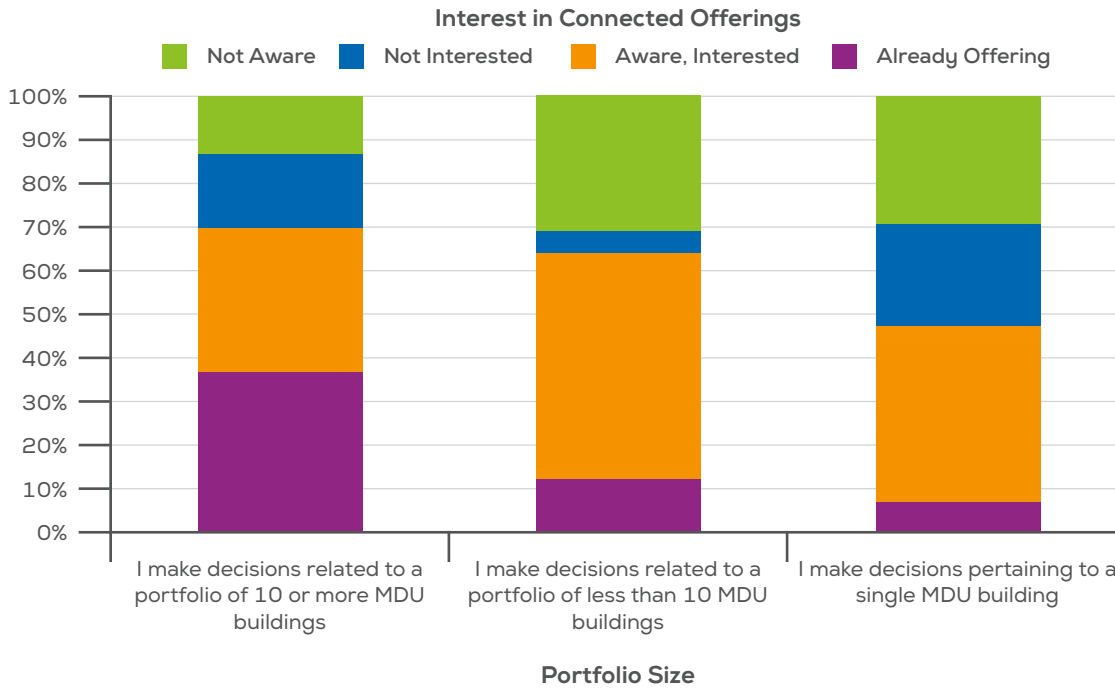
Cost, far and above all other factors, is the biggest barrier to adoption by owners, operators and developers, followed by occupant privacy concerns. While a small portion of respondents rank "confidence in offering benefits" as a major barrier, it is clear that they remain unconvinced that the lifetime benefits outweigh the initial costs of offerings.

Figure ES.16 Owners, Operators and Developers: Barriers to Adoption, n=58



Further, awareness of and interest in connected offerings is found to be significantly higher among operators and developers of large portfolios of MDUs, reflecting the focus of suppliers on the attractive scale offered by these targets. Small property managers and developers, as well as operators of single buildings, are individually less attractive of a target than a larger firm, though the overall market for offerings tailored to operators at smaller scales is large.

Figure ES.17 Owners/Operator Portfolio Size and IoT Interest, n=110



Smart MDU Business Opportunities - Chapter 4

Connected devices and services within MDU buildings and individual units can be combined in numerous combinations to enable simple, compound, or complex applications. Five distinct value added application segments have been identified that create value for building occupants or operators in different ways.

- **Resource Management**: Applications that monitor and analyze resource and energy usage data to inform and enable efficient consumption and reduce costs.
- **Peace-of-Mind**: Applications that enable remote monitoring of home and occupant safety and connecting to third party security services.
- **Building and Equipment Management**: Applications that monitor and manage equipment/building usage and performance and/or provide greater visibility into operations and reduce operating expenses.
- **Comfort and Convenience**: Applications that enable automation and/or wireless control of devices and services to increase comfort and ease of use while reducing device and appliance failure.
- **End-User Engagement**: Applications that use data and analytics to increase the value of services offered by equipment manufacturers, traditional or specialist service providers, or third-parties.

Each of these applications, depending on the complexity of the use cases installed in and across MDU buildings and units, stand to create value for multiple stakeholders. Building operators/managers stand to gain the most from Smart Systems apps in MDUs, with offerings either reducing operating expenses or increasing margins through enhancing occupant acquisition, satisfaction or retention.

Figure ES.18 Overview of Value Proposition of Smart Systems for Suppliers

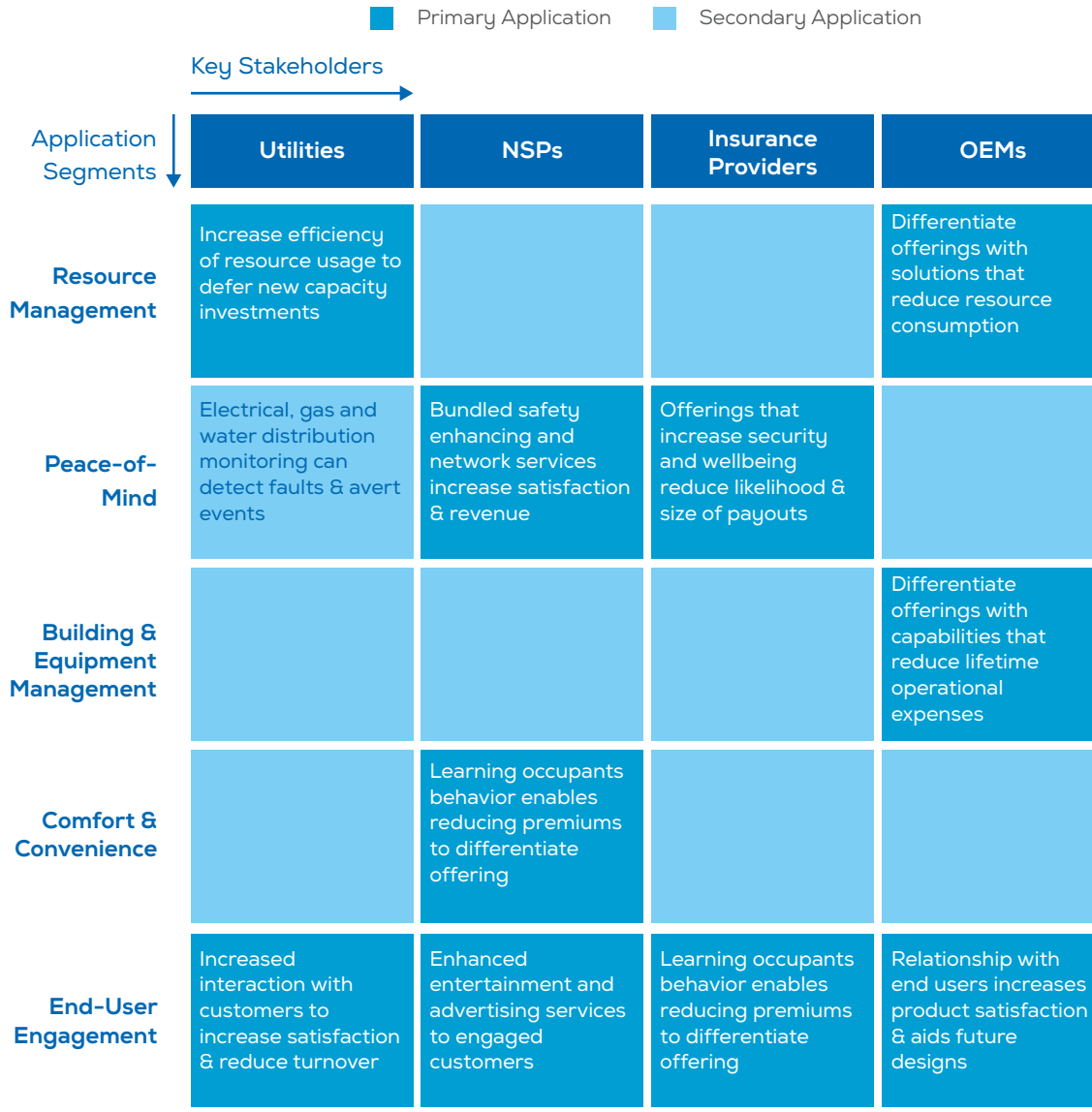


Figure ES.19 Overview of Value Proposition of Smart Systems for End-Users

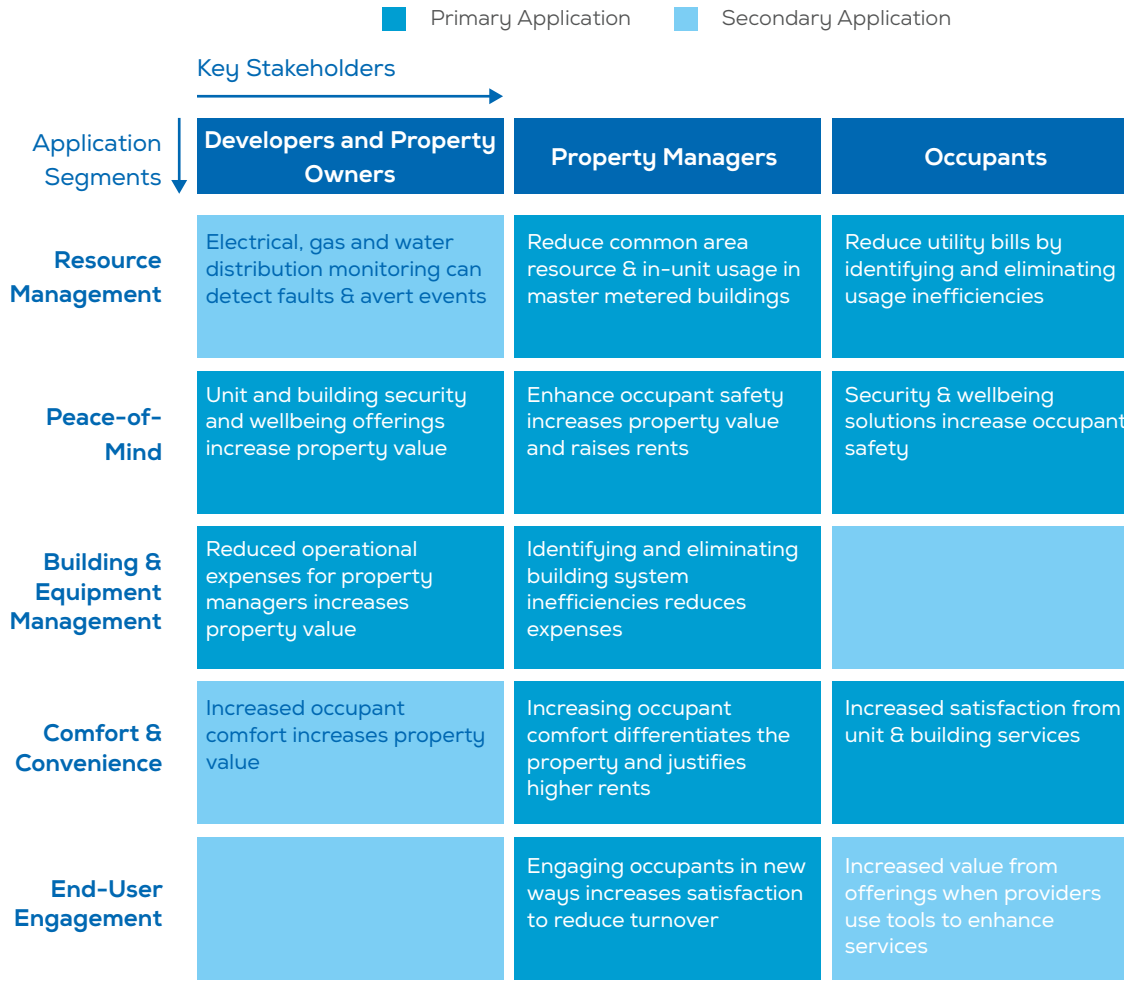
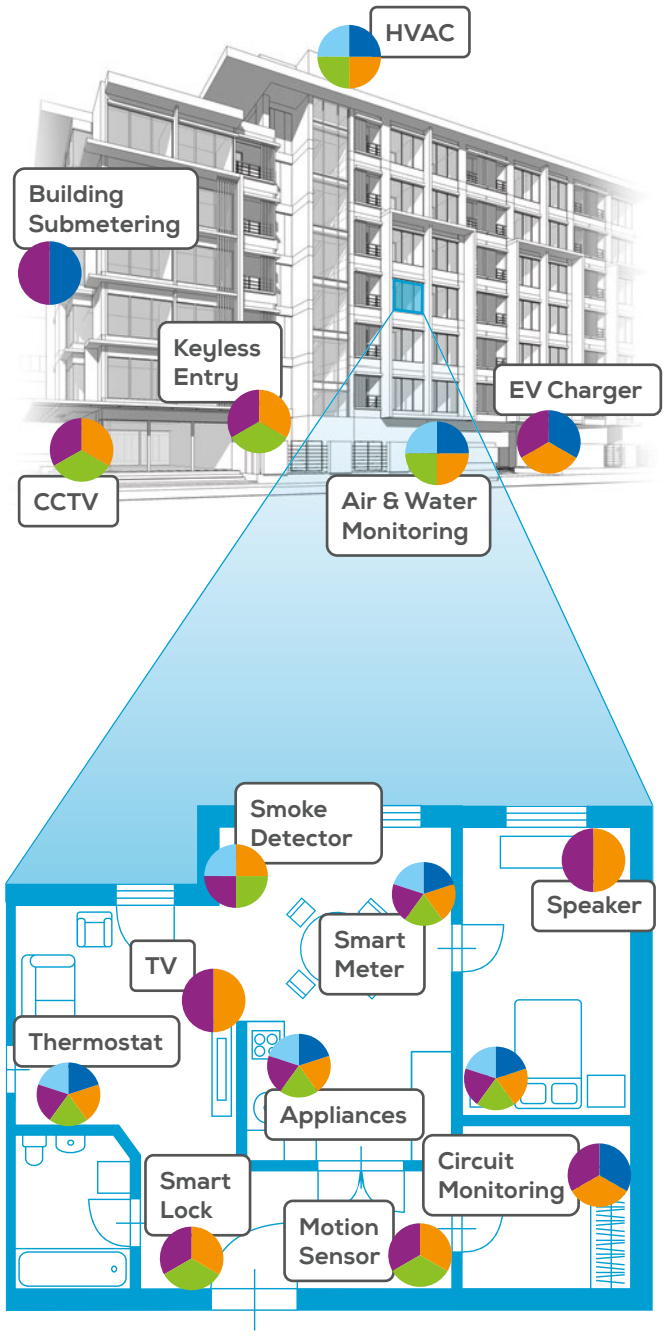


Figure ES.20 Overview of Devices within Application Segments and the Stakeholders Who Stand to Benefit



Resource Management

Applications that monitor and analyze resource and energy usage data to support efficient use and reduce costs

Primary Value Captured By:
• Occupants • Building Operators

Comfort and Convenience

Applications that use wireless control or automation to increase comfort and ease of use and reduce offering failure

Primary Value Captured By:
• Occupants • Building Operators

Peace-of-Mind

Applications that enable remote monitoring of home and occupant safety and connect to third party security services

Primary Value Captured By:
• Occupants • Building Operators

End-User Engagement

Applications that use end user data to increase the value of offerings delivered by OEMs and service providers

Primary Value Captured By:
• OEMs and Service Providers • Building Operators

Building & Equipment Management

Applications that manage equipment and building usage to identify inefficient operations and reduce operating expenses

Primary Value Captured By:
• OEMs and Service Providers • Building Operators

For each of these five application segments, Chapter Four of this report details:

- The scope of potential use cases, including the technical complexity and value created for various stakeholders;
- The scale of the revenue opportunity across MDU building types;
- Trends and forces affecting the desirability, development and deployment of use cases of varying complexity;
- Key factors identified from the market study that indicate interest in application adoption;
- Case studies highlighting implementations of use cases of varying degrees of complexity and benefits for various stakeholders;
- Channels to market by which manufacturers and service providers deliver new offerings to end-users;
- Conclusions and recommended actions for MDU stakeholders include:
    - Electric Utilities
    - Network Service Providers
    - Insurance Providers
    - Specialty IoT Service Providers (e.g., energy management providers, security monitoring providers)
    - IoT Hubs, Platforms, and Software Providers
    - HVAC-R and Water OEMs
    - Lighting OEMs
    - Appliance OEMs
    - Electrical OEMs
    - Security OEMs
    - Building Products OEMs

Conclusions and Implications - Chapter Five

Key Opportunities and Targets

The exact makeup of offerings, the types of stakeholders to target with those offerings, and the solution delivery paths tend to vary by application, but there are guidelines for success that are broadly applicable as suppliers consider offering connected devices and services.

Property Manager Priorities are the Key Variable. The property manager persona has the biggest impact on the type of solutions desired and the delivery of those solutions.[10] Owner/occupant decision-making primarily focuses on device and service investments that increase in-unit comfort, convenience, and peace-of-mind, or reduce unit operating expenses. On the other hand, private owners/managers are seeking connected offerings that either significantly increase the value of units or provide differentiating value to units and create long-term operational expense reductions for themselves. The value to small and large property management firms varies with the MDU structure. In small buildings without onsite staff, remote access and equipment management reduces manager time and labor costs, while these same offerings in larger properties with dedicated staff enable managers to reduce staff expenses and increase response quality. Managers of large properties also seek solutions that utilize scalable cloud tools that extend property management capabilities across a large portfolio of properties.

Creating Multi-Stakeholder Value. Suppliers stand to gain a unique, sustainable competitive advantage from offerings that create new end-user value while enhancing their own service delivery. Differentiated solutions enhance customer loyalty, and data collected from connected offerings enables enhanced value creation over time to reduce turnover. Meanwhile, reducing friction in service delivery enables suppliers to actually reduce the cost of offerings relative to competitors, further strengthening the value proposition of their offerings.

Access management provides significant convenience value for occupants while enabling managers

to limit access to a defined set of tenants and reducing time and labor expenses during tenant turnover. The device capabilities and overall scope of solutions will vary with targeted occupant personas, with ready-to-control holistic apartment/condo offerings ideal for higher income occupants. Owner/operators of buildings serving lower-income occupants may create the most value by simply providing the network backbone and platform/IoT hub tools, enabling occupants to invest in the devices and services that they can afford or prefer.

Opportunity Targets and Timing. Managers of all-inclusive or high turnover properties are most likely to adopt offerings that provide resource consumption and building access management. Targeting large property managers provides suppliers an opportunity to capture a significant volume of deployed devices if they can install offerings across all future new build or retrofit projects in the portfolio. Small property management firms and individual owner/managers may find new connected appliances and building systems prohibitively expensive for their limited capital budgets, while large property managers undergoing retrofits and developers of new builds may be capable of making upfront investments that will reduce long-term expenses.

DIY and add-on offerings that provide energy management, equipment and appliance monitoring and control, and security have a significant opportunity to enhance occupant value or reduce operating expenses without requiring major renovations. Retrofitting unit-by-unit during occupant turnover presents the largest opportunity for devices requiring owner/operator installation in MDUs, granted that firms are able to develop cost structures suited for the small margins and lack of scale which unit-by-unit retrofits offer.

Technology Success Factors

The ability to create new value in the background of users' lives, enhancing comfort, convenience, peace-of-mind or reducing costs without additional user interactions with a device or service is key to successful adoption of offerings. Offerings that leverage open source conventions have the potential to create the most value by seamlessly interacting with adjacent devices and value-adding services.

Software Enabled Interoperability. Operators are looking for offerings that integrate disparate HVAC-R, water and air distribution, lighting, electrical distribution, and security systems onto a single IP-based platform that enables remote monitoring and control with minimal complexity.[12] The ability for disparate systems to communicate with each other and share data with analytics engines and automation services is critical to enable these tools to create value for MDU stakeholders across the value chain. A focus on open source data models and communications protocols enables this communication to occur innately, though middleware platforms and hubs are being utilized to provide interoperability in the absence of adhered-to standards.

Benefits in the Background. Operators and occupants alike seek tools that move beyond data visibility and control to actually reducing costs and/or increasing comfort, convenience, and peace-of-mind with automated actions that occur in the background. Rising consumer adoption of machine learning services, especially in the form of digital assistants offered via smart phones and speakers, give service providers a powerful interface for connecting with users and tailoring services to individual needs.

Flexibility and Extensibility. End-users are eager for solutions that readily adapt and expand as needs change, technology evolves, and regulatory and market factors shift the economic rationale for adoption of connected offerings. Cloud-based platforms for managing IoT offerings within a single MDU can readily be scaled to provide monitoring and control of systems across a portfolio of buildings. As costs of devices and services declines and the demands of a shifting occupant base encourage operators to invest in new offerings, the ability to easily incorporate additional solutions will differentiate MDU offerings.

Distributed Architectures Unlock Smart Systems. Intelligent processing and transactional computing cannot occur on clients with intermittent server connections, proprietary "locked" platforms, or large installed footprints. Networking technologies and the standards that support them must evolve to the point where data can flow freely among sensors, computers, and actuators. Software to aggregate and analyze data, with intuitive user/system interaction design techniques, must improve to the point where huge volumes of data can be absorbed by human decision makers or synthesized to guide automated systems more appropriately. Devices that host intelligent software components must communicate to other devices directly (peer-to-peer) or to logical collections of devices (peer-to-group) in any programming language, and do so autonomously, with or without network connectivity.

Key Supplier Considerations

Technology, equipment and service suppliers have opportunities to leverage connected devices and services to differentiate their offerings and increase margins. Success depends on their ability to develop business models that enable efficient delivery and support of those offerings.

Collaborate Between Organizations. Industry participants are beginning to realize the importance of having continuous interactions within an ecosystem of partners and allies. As information, automation and equipment systems become more complex, customers are looking to suppliers to provide broader services and address business outcomes. Companies who choose to address the Smart Systems market on their own will undoubtedly fall short of their true potential. Partnerships that encompass all aspects of production and service provisioning are necessary to create and capture value from increasingly complex Smart Systems. OEMs and service providers need to partner with technology and device manufacturers to develop the requisite sensing, connectivity, analytics, control, and autonomy capabilities for new and enhanced services. Providers must keep an eye on the adoption of in-unit connectivity platforms, whether a specialized hub, gateway, smart phone or speaker, as popular offerings present a valuable channel to providing new services to end-users.

Establishing a Service-Oriented Business Model. Simple, product-oriented business models ignore significant opportunities for revenue throughout a product's life cycle. Equipment manufacturers must recognize the opportunity to leverage sensing and connectivity in their offerings to provide new monitoring and management services. Traditional service providers can utilize connected devices to capture new revenues with enhanced or new adjacent services, increase customer satisfaction and acquisition, and even increase margins by reducing the friction of service delivery and value creation. As connected devices proliferate, suppliers will be able to establish an ongoing relationship with customers based on post-sale services that provide greater value to end-users. Senior executives must recognize that realizing this opportunity requires shifting from a product-centric to a solution-centric business model.

Process Differentiation. Successful suppliers are shifting from a focus on product differentiation to focus on process differentiation, including customer service, supply chain, delivery, and support. Initial and ongoing support of connected offerings is one of the most significant criteria for success, creating a major opportunity for installers and systems integrators as equipment and tech suppliers are often poorly organized to provide these services. Suppliers must therefore develop business models that incorporate installer and integrator margins to ensure that these parties are adequately incentivized to assist in solution delivery.

Address the Reality of Customers' Environments. As customers continue to invest in new network and communications technologies, a significant premium will be placed on leveraging legacy equipment due to the large investments required to replace them. Since legacy equipment will continue to be part of building systems for years to come, solutions that integrate and share legacy system data with new systems will be highly valued.

Security Cannot Be Overlooked. The importance of securing systems to prevent theft of data and IP and ensuring the safety of operations and building occupants requires players to prioritize security and support throughout the product's life. Adopters, often possessing little background or interest in IT systems, must be provided with the appropriate tools and support to effectively and securely deploy and use connected offerings.

Organizing for the Future of Smart Systems in MDUs

There are several significant opportunities for emerging and incumbent equipment and service providers to become Smart Services providers in MDUs. Rising technological fluency and consumer demand for smart devices and services with proven value will accelerate adoption, enticing more players to take part in this market. As the underlying technologies advance, processing tools become increasingly powerful, and innovative business models are developed, new opportunities will arise - companies must begin preparing if they wish to remain competitive.

Brokering Emerges with Proven Data Privacy: Transparency and trust will enable suppliers to utilize end-user data to provide new services and benefit from both new revenue opportunities as well as enhanced service value and delivery. If suppliers can prove that end-users' personal devices and data are safe from external attack, users have demonstrated a willingness to share data with suppliers in exchange for more personalized, higher value services. Suppliers must embed data capture and two-way communications into offerings, make clear the benefits that users will capture by sharing data, and clearly define data usage terms.

Platform Players Leverage Ecosystem Control: IoT hubs and platform offerings are driving interoperability between devices and services from a range of vendors, overcoming the lack of standardized protocols for data formatting and communicating within and across buildings. The providers of these platforms sit at a critical control point in these ecosystems, particularly players with both a dedicated customer base and strong relationships with suppliers who can provide a comprehensive suite of offerings. From their control point of ecosystem offerings, platform providers will expand their reach from device and data management and application enablement into adjacent services. Asset management, insurance services, security monitoring, resource management, energy delivery within increasingly local grids, and even network services all fall within the realm of services that disruptive platform providers might expand into from their ecosystem control point.

Hidden Complexity with Intelligent Automation: As more devices become connected and enable more services to be delivered, the complexity required to manage the system threatens to erode the value that users receive. Ensuring that net value creation is positive (that connected value exceeds complexity cost) means that the vast majority of device and system interactions must occur in the background of users' lives. Put another way, suppliers should be less focused on whether to provide computing device interactions via touch or voice interfaces and more focused on figuring out how to avoid interactions altogether. Open source semantic data models are enhancing the ability of machine learning software tools to contextualize and automate services based on programmed and learned preferences. In this sense, artificial intelligence has the potential to be not just another software tool, but the next platform from which computing takes place, orchestrating automated, personalized actions in the background of end users' lives that maximize efficiency while increasing comfort, convenience, and peace-of-mind.

MDUs are a Proving Ground for User-Focused Smart Buildings

The MDU market, representing over 40 million units in six million buildings across the United States and Canada, has remained underserved by the suppliers of commercial and single-family residential buildings and thus remains largely unconnected, creating a significant opportunity for suppliers. MDUs sit at the intersection of residential homes and commercial buildings, forcing suppliers to cater

to a unique set of needs. While building structures and centralized HVAC-R and air/water distribution systems are reminiscent of commercial buildings, the close consideration of individual unit occupant needs is similar to the demands of the single-family home market.

The fragmentation of the supplier base is exceeded by that of the adoption base, with owner/operator type, building physical structure, and occupant persona affecting the desire for various use cases, the makeup of those solutions, and the optimal delivery channel. Ultimately, the variability of building types, number of stakeholders involved, and low margins are the primary reasons that commercial building automation players have not developed MDU solutions to date. Meanwhile, home automation providers have failed to develop solutions which create value for both MDU occupants and building operators/managers while adding minimal complexity to holistic building management.

The era of buildings that do not create tailored value for building users who expect connectivity-enabled convenience in all aspects of their lives is rapidly coming to a close. Ultimately, offerings that create value for building operators while also delivering personalized value to occupants/tenants will evolve out of the MDU market and dominate the buildings space. The MDU market will be a proving ground for innovative offerings; solutions that find success in MDUs will expand across the market and create broad-reaching, multi-stakeholder value for users in all building types.

Notes

1. Interview with Product Manager at Optergy, 2 February 2017; Director of Product Management at Dude Solutions, 2 February 2017
2. Interview with Executive at BuLogics, 11 January 2017
3. Interview with Executive at StratIS, 19 January 2017
4. Interview with VP at IOTAS, 12 January 2017
5. Interview with Executive at WhiteSpace Building Technology Advisors, 05 January 2017
6. US Census Bureau, Statistics Canada, National Multifamily Housing Council, HRI Analysis
7. Interview with Vice President at NMHC, 13 January 2017
8. Interview with VP at the National Multifamily Housing Council, 30 January 2017
9. Interview with Executive at Dwelo, 27 January 2017
10. Interview with Vice President at Alarm.com, 05 December 2016
11. Interview with Editor of AutomatedBuildings.com, 05 January 2017
12. Interview with Executive

CABA™

Connected Multi-Dwelling Units and the Internet of Things

LANDMARK RESEARCH PROJECT

888.798.CABA (2222)
613.686.1814

Connect to what's next™

www.caba.org