Trends on the Role of Internet of Things Technology in Senior Care

Market Trends, Technology Drivers, Initial Learnings

A Technical Paper prepared for SCTE•ISBE by

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Abstract

Demographic shifts in the United States project a rapidly aging population. The number of citizens aged 65 and above will exceed the number of children by 2030. Longer life spans, smaller families, relocation of working age children away from aging parents have all contributed to a burgeoning opportunity for targeted technology to fill growing gaps in care. When elderly become unable to live fully independently and in-home care options are limited, what options exist? Assisted Living is a growth business in response to this phenomenon. Remote diagnostic health management and telepresence are largely absent. Residents generally lack technology savvy needed to avail themselves of such quality of life enhancing technology. This discussion explains specific proof of concept and test use cases to demonstrate benefits of IoT, Robotics/Telepresence, and AI in this emerging market. It pinpoints where and how Service Providers can deliver service packages to a growing industry.

Content

1. Demographic Change and Rapid Demand growth for Senior services in the United States

As of Aug 10, 2018, the total population of the United States as reported by the census Bureau was 328,325,857. Population change occurs at the rate of one birth every 8 seconds, one death every 12 seconds, and net gain of one citizen every 12 seconds (immigration + births) – deaths. Projections from the Census Bureau portray a significant aging of the overall population, with the Adults 65+ category growing from 15.2% in 2016 to 23.5% in 2060. Meanwhile the percentage of children <18 is projected to decline from 22.8% to 19.8%. The number of Adults 65+ is projected to exceed the number of children in the country by 2033.
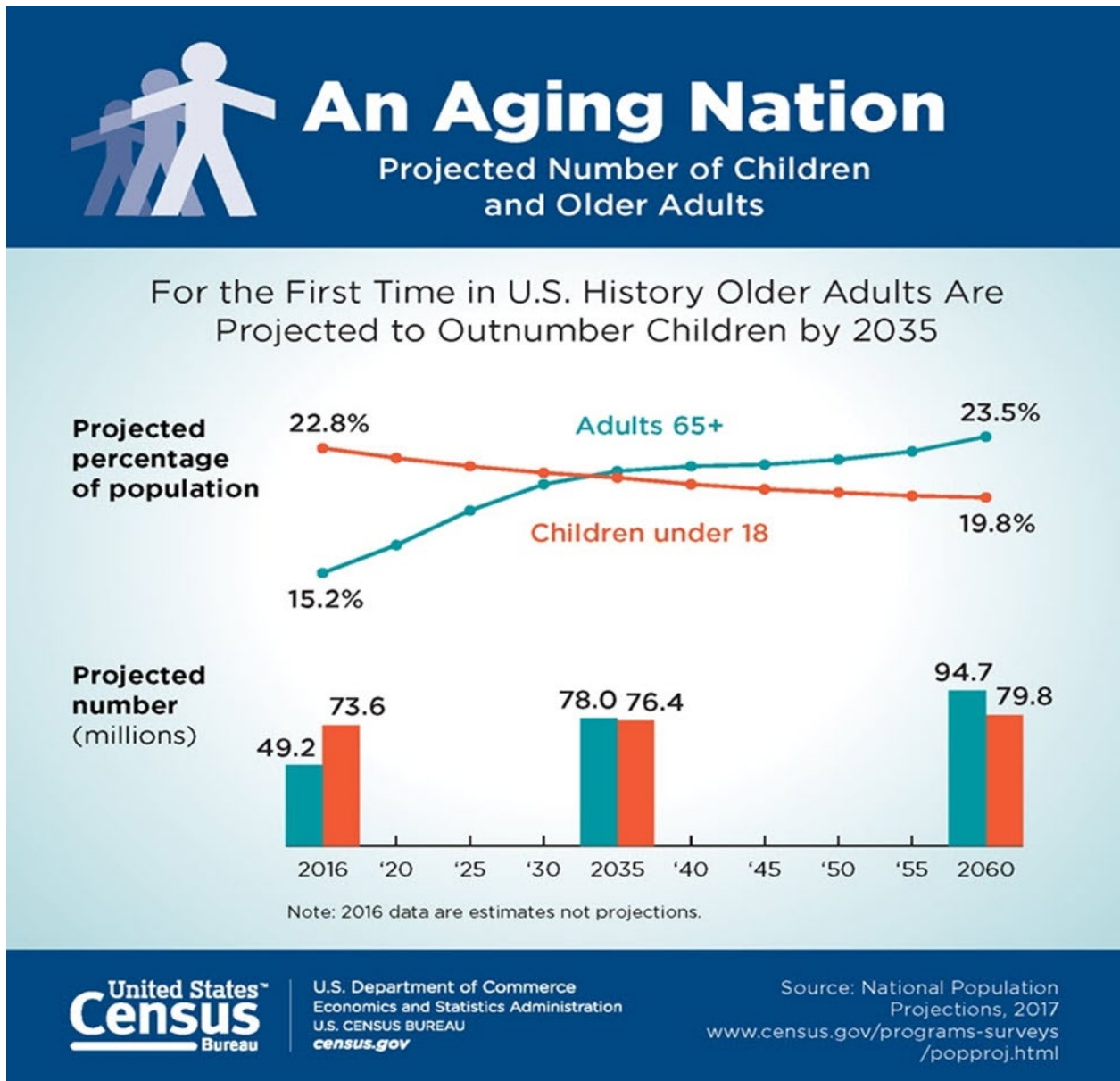
Figure 1 – Projected Number of Children and Older Adults [i]

Another significant aspect of the demographic shift is the ratio of working age adults per dependent Youth or Adult 65+ able to fund subsides for caregiver services. In 2009, the number of people living in multi-generational households was 17%, or 51.5 million, where aging parents received some help with ADL's (Activities of Daily Living). accounting for 21% of Elderly needing care. In 2018, that statistic has increased to 20%, or 64 million people. [ii] While much of this trend can be attributed to higher overall cost for housing, it also reflects the larger economic trend of labor cost reduction and automation that is reshaping the economy. In the Senior Care market, opportunities to improve service and reduce cost are just now coming under scrutiny.

One-in-five Americans live in a multigenerational household
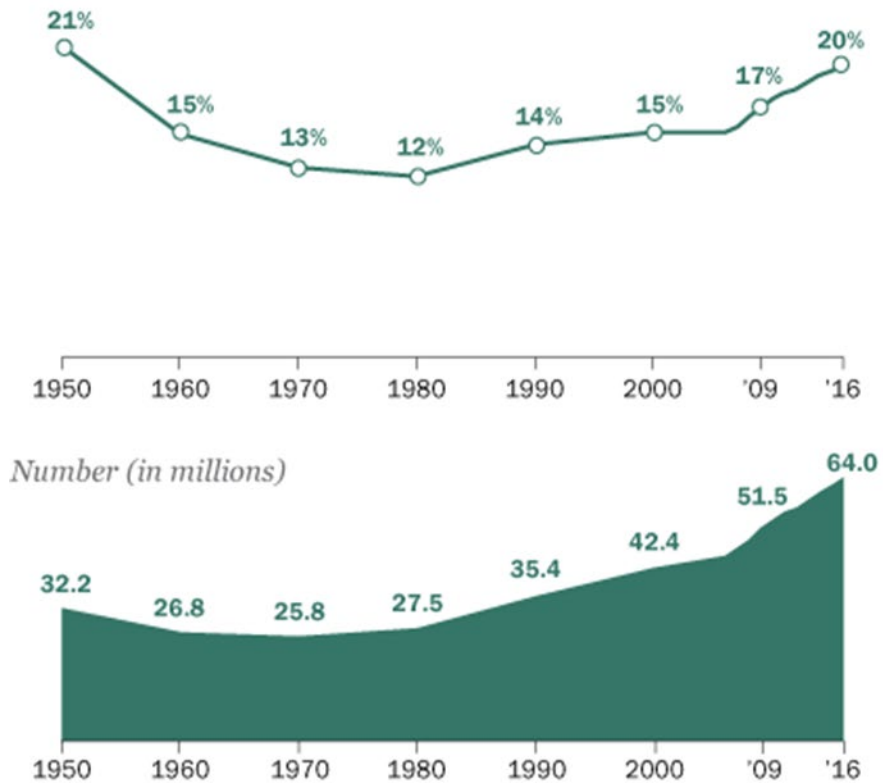
% of population in multigenerational households

Number (in millions)

Note: Multigenerational households include at least two adult generations or grandparents and grandchildren younger than 25.
Source: Pew Research Center analysis of 1950-2000 decennial censuses and 2006-2016 American Community Survey (IPUMS).

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Figure 2 – Multigenerational Households

Of note is the shift in this statistic is that the ratio of parents living with children has greatly declined since 1940 while children and adult children living in their parents' home has increased as shown in the chart below. (Fig 3)

Young adults most likely age group to live in a multigenerational household

% of population in multigenerational households

63 — Ages 85+
32 — Ages 25-29
25 — Total
26
19
18
13
12
14
33
25
20

1940 '50 '60 '70 '80 '90 2000 '10 '16

Note: Multigenerational households include at least two adult generations or grandparents and grandchildren younger than 25.
Source: Pew Research Center analysis of 1940-2000 decennial censuses and 2006-2016 American Community Survey (IPUMS).
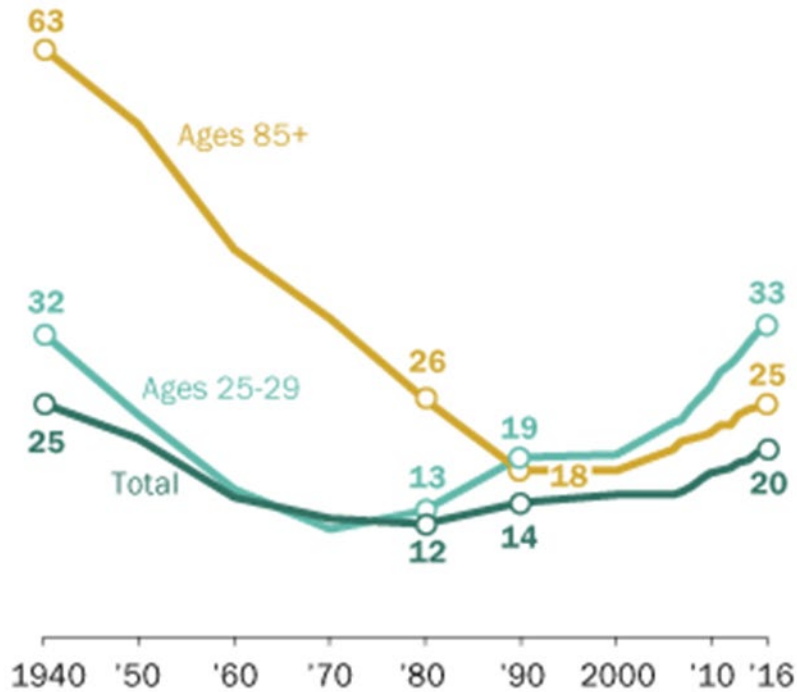
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Figure 3 – Multigenerational Households and Youth

This oldest segment of the population, as well as most of the Baby Boom generation, are expected to pursue a lifestyle of aging in place. This is one example of where IoT technologies can provide convenience, cost reduction, reduced stress on caregivers, while also enhancing the quality of life and well-being of Seniors.

Demographic shifts (figure 4) over the next two decades will exacerbate deficiencies in availability and affordability of Senior care services for the Baby Boom generation. In 2030, they will begin to turn age 85, entering the point in their life where assistance with one or more ADL's will likely be needed.

Figure 9

■ Despite longer work spans, the relative size of the workforce will shrink to less than one worker per dependent by 2030
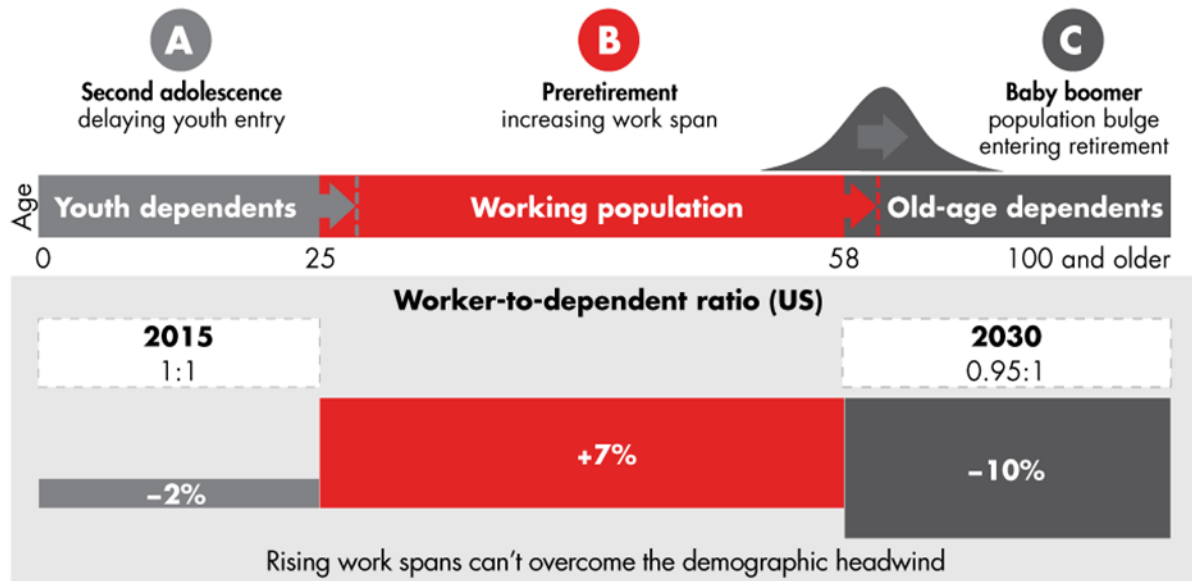
Figure 4 – Workspans (US Bureau of Labor Statistics)

Seniors unable to live with caregiving relatives must rely on services when confronted with the need for assistance with Activities of Daily Living. Services may then be obtained from municipalities, For-profit and Non-profit service providers, local and remotely located relatives, and individual volunteers. Government assistance is reserved for individuals that qualify for Medicaid. The Institute on Aging, a Non-Profit Senior Care organization in San Francisco, characterizes this segment of the Senior population with the following facts:

Living to 85+

- In 1900, only 100,000 Americans lived to be 85+.
- By 2010, that number had grown to 5.5 million. This is the fastest growing age group of elders.
- By 2050, the 85+ age group will reach 19 million—24 percent of older adults and five percent of the total population.
- Some researchers say the 85+ group will grow even faster than this, because death rates at older ages will decline more rapidly than the U.S. Census Bureau predicts.

Living Alone

- Of the older adults who were living outside nursing homes or hospitals in 2010, nearly one third (11.3 million) lived alone.
- Older women are twice as likely as older men to live alone (37 percent and 19 percent, respectively). In 2010, 72 percent of older men lived with a spouse, only 42 percent of older women did.
- Living arrangements differ by race and ethnicity. Older non-Hispanic White women and Black women are more likely than women of other races to live alone (39 percent each, compared with about 21 percent of older Asian women and 23 percent of older Hispanic women).
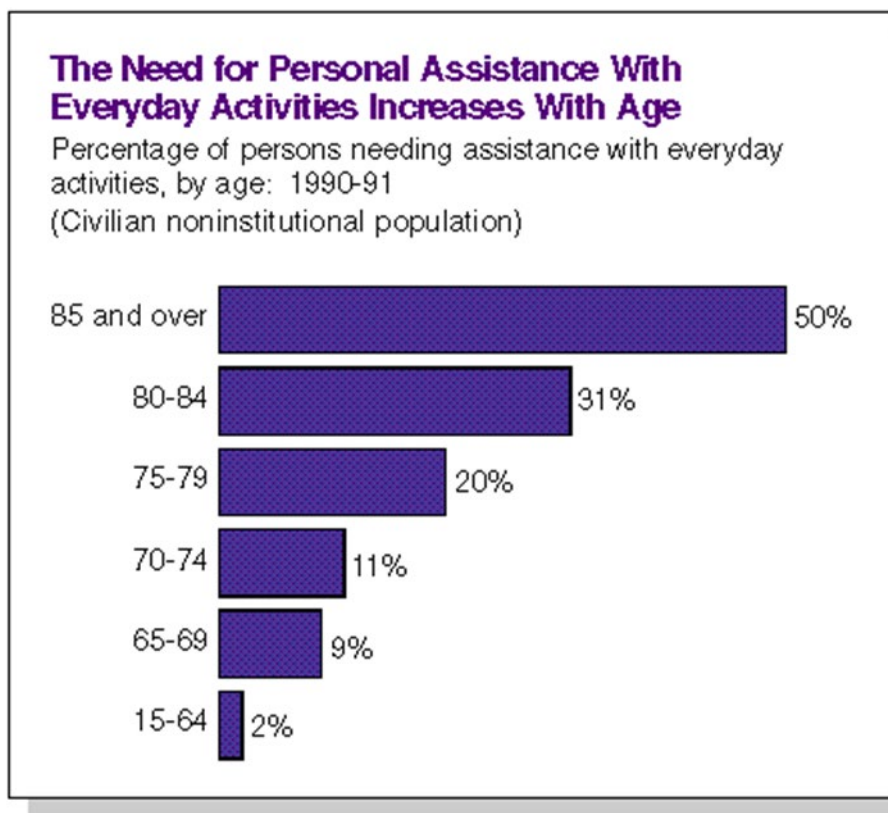- The likelihood of living alone increases with age. Among women age 75+, almost half (47 percent) lived alone in 2010..[iii]

The Need for Personal Assistance With Everyday Activities Increases With Age

Percentage of persons needing assistance with everyday activities, by age: 1990-91
(Civilian noninstitutional population)

Age	Percentage
85 and over	50%
80-84	31%
75-79	20%
70-74	11%
65-69	9%
15-64	2%

Figure 5 - US Census Bureau Statistical Brief, 1995, Revised Oct 31, 2011

As the US population shifts to more elderly citizens, the role of Internet of Things technology will only increase as we grapple with the cost and burden of care. Many WWII and Silent Generation Seniors in the upper age brackets of 85 and beyond, express strong desire to retain independence, age in place for as long as possible, and do not wish to burden their children for long term care. Yet, long term care costs are extreme, ranging from $3000-$4000/per month for Assisted Living residence with only lodging, meals, activities, excursions, and housecleaning included. Any additional service such as laundry, medication management, or personal care to assist with ADL's comes at a premium that can quickly add hundreds or thousands of dollars to the monthly cost. At its most extreme, Memory care for residents with Alzheimer's or other cognitive issues can cost up to $10,000 per month, depending on region. Medicare

does not cover any form of assisted (Custodial, or ADL) living. Seniors not prepared with Long Term Care Insurance must deplete their entire nest egg before becoming qualified to obtain Medicaid subsidies for long term care. A common scenario is for a widow to sell her home and use the proceeds to pay Assisted Living facility costs until depleted. The Long Term Care Insurance market has recently collapsed to only 15 providers due to the burden of current claims on underwriters. In 2018, LTCI is difficult to obtain and expensive with premiums that have increased dramatically since 2012. A snapshot of 2016 Care costs from Mutual of Omaha: (Figures 5 and 6)

| **Home Health Care**	**Per Hour**
Home Health Aide	$20.54
Licensed Practical Nurse (LPN)	$57.08
Registered Nurse	$68.14
Assisted Living Facility	**Per Month**
One Bedroom Unit	$3,656.54
Nursing Home	**Per Day**
Semi-Private Room	$200.46
Private Room	$216.63

Figure 6 - Average Costs in Georgia

Annual cost for home health aide is based on services received 44 hours per week, 52 weeks per year. Annual cost for LPN and RN can be determined based on the actual number of hours services are required.Source: Mutual of Omaha Insurance Company's Cost-of-Care Study conducted by LTCG, 2015; released April 2016
Source available upon request.

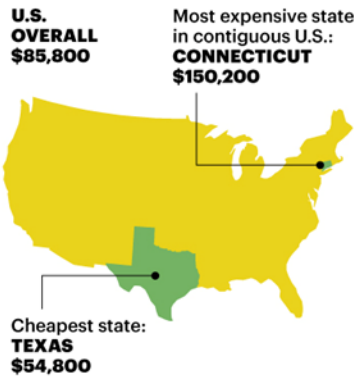**The Unpredictability of Long-Term Care**

HOW LONG ...
The duration of paid care among 65-year-olds who will need it someday varies widely, but for many it is under one year.

Less than 1 year **48%**
5 years **13%**
1 to 1.99 years **19%**
2 to 4.99 years **21%**
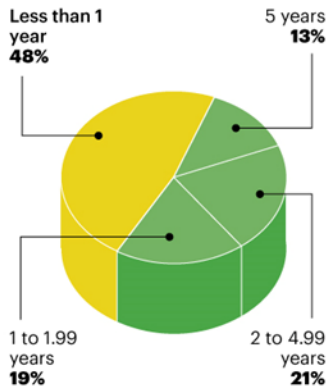
PERCENTAGES EXCEED 100% BECAUSE OF ROUNDING. SOURCE: DEPARTMENT OF HEALTH AND HUMAN SERVICES

HOW MUCH ...
The median annual cost of nursing home care depends on your state.

U.S. OVERALL $85,800

Most expensive state in contiguous U.S.: **CONNECTICUT $150,200**

Cheapest state: **TEXAS $54,800**

PRICES ARE FOR A SEMIPRIVATE ROOM. THE MEDIAN ANNUAL COST IN ALASKA IS $292,000. SOURCE: GENWORTH

YOUR COSTS
One in four people now age 65 will face over $50,000 in lifetime out-of-pocket long-term care expenditures.

Out-of-pocket spending | Share of people who will spend this amount
$250,000 or more — **9%**
$150,000 - $250,000 — **4%**
$50,000 - $150,000 — **11%**
$0.01 - $50,000 — **13%**
$0 — **63%**
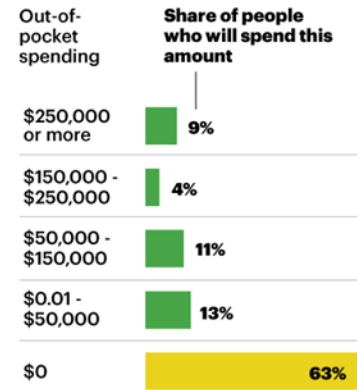
SOURCE: DEPARTMENT OF HEALTH AND HUMAN SERVICES

Figure 7 – Unpredictability of Long-Term Care

2. IoT Technologies with potential to provide or enhance caregiving services to the elderly

Senior living modes and opportunities for available and rapidly emerging IoT technology to provide or enhance services needed by Senior groups, focused on the 85+ age group:

Table 1 – Senior Living Mode

IADL, ADL Need	Senior Living Mode						
	Alone	Senior Village	Minor In-Home	Significant In-Home	Constant In-Home	Assisted Living +	Skilled Nursing
Monitoring	S T W	S T W	S T W	S T E M	S T E M	S T W E	S T W E
Alert- Personal	S T W	S T W	S T	S T W	S T W	S T W	M
Alert- Physical	S T W	S T	S T	S T	M	S T W	M
Communication	S T	S T	S T	S T	N/A	S T	S, T
Medications	E R W	E R W	E R W	E R W	E R M	E R W	S T W E
Transportation	T	T	T	T	N/A	N/A	X
Visitation	T R	T R	T R	T R	T R	T R	X

Cooking	R	T R	T R	N/A	N/A	N/A	X
Housework	E R	E R	R	N/A	N/A	N/A	N/A
Personal Finance	T	T R	T R	N/A	X	T R	X
Home Maintenance	E	N/A	E	N/A	N/A	N/A	N/A
Hygiene	E W	E W	E W	E W	X	X	X
Eating	E W	E W	E W	E W	X	X	X
Dressing	R	R	R	E W	X	X	X
Mobility	R	R	R	R	X	X	X
Continence	W	W	W	E W	X	X	X
Cognitive	N/A	R T	R T	N/A	N/A	R T	N/A

S = Security System, W = Wearable Sensor, E = Environmental Sensor, R = Robot, T = Telepresence/com

M= Medical, X = Incompatible with Living Mode, N/A= Not Applicable

Definitions:

Security System/Smart home – Includes standard sensors (cameras, motion detectors, smart home devices) for home physical security where access is shared with Care persons or loved ones. Two-way voice capable.

Wearable Sensor – Includes ID and location devices, call buttons, through-skin sensors/dispensers for measuring body functions, accelerometers.

Environmental/Health Sensors – Includes all fixed detectors not considered ordinary Security/Smart home devices. Includes air quality detectors, lavatory fixtures with biometric and sample processing, as well as the standard functions of temperature, humidity, and air pressure.

Robot – A programmable machine that performs a task. Examples include medication dispensers, meal delivery, cleaning, companion or control device.

Telepresence – Two-way video and mobile screen platforms to interact with Seniors and allow remote visitation. Examples include Beam and Double.

Medical – Specific medical devices that are currently out of scope for integration with commercially available IoT components but includes Tele-Health service systems such as Trapollo.

3. IoT Architecture

IoT systems vary widely in composition, capability, and purpose. A general model proposed by J. R. Fuller of Online source Tech Beacon describes stages of IoT as shown in Figure 7:
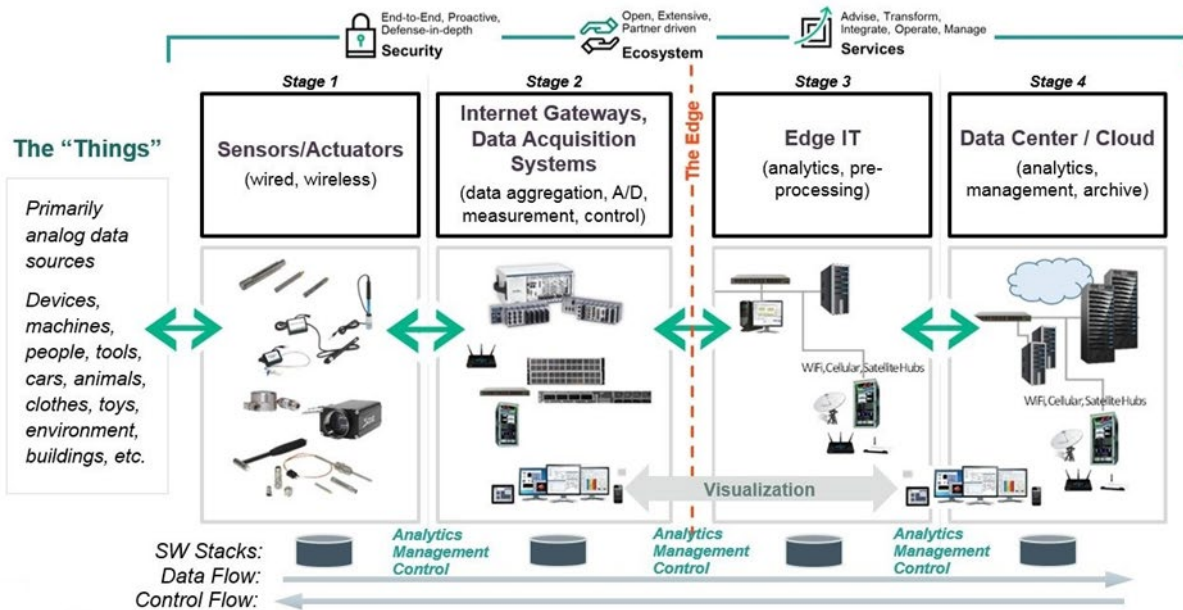

Figure 8 – The 4 Stage IoT Solutions Architecture

The scope of this paper does not include detailed comparisons of all technical approaches but a general assumption is that all sensors and data acquisition devices can be accessed, controlled, and managed for their purpose.

4. Current and Near Term IoT Opportunities

Historically, Aging in Place accommodations have consisted primarily of physical changes to the residence, making it as barrier free as possible or reasonable. Aging in Place is a popular choice among Seniors and creating new demand. Stair-lifts or elevators may be needed in a multi-story home. Ramps at door sills or other obstacles, lavatory adjustments, and transportation arrangements are those basic elements.

Traditional security systems and increasingly available wireless integrated services and user-installed that include modern features such as remote management of many smart devices. For Seniors, door locks, doorbell cameras, and additional detection can form a basic IoT starter system. For caregivers, such a system helps in determining if the Senior is moving about as expected. For a family care giver, these two items provide the means to safely leave the home, yet stay in touch with their Senior and this can be a great relief. It can lessen the risk of a third party caregiver misbehaving with the Senior or their property. A best practice of using IoT technology with Seniors is that you cannot expect someone in their mid-80's or above to learn how to use a new technology. For most Seniors of advanced age, smart device management may be completely confusing.

An alternative interface for Seniors is voice control, such as an Amazon Echo, that can tie all services into a central hub and simplify the user interface. Service Providers are deploying packages, such as Cox Communications Homelife, to simplify the user interaction with the system. Cox is currently researching interfaces that Seniors are more receptive to. One such example is the Social Robot Platform, Jibo. Cox trialed this approach for "Homelife Care" in Oklahoma City this year with strong user ratings and feedback.

IoT technology as a whole is still maturing while gaining momentum through rapid consumer and industrial automation adoption. Operating systems vary widely and consumer systems require some administration, so if you plan to provide your Senior loved one with a system, current choices are either well-integrated but expensive systems or DIY open standards components. Provider based services usually come with a monitoring service monthly fee.

In Assisted Living Facilities, at present, the use of IoT technology in facilities is generally not present. Other than an in-person visitation, it can be difficult to know if your loved one is receiving adequate care and value for their expense. At Cox, we are intending to test the use of mobile telepresence, using the Double Robotics device to enable remote visitation of residents. We will also investigate the utility of camera-based monitoring. While the Senior Care industry is still undergoing massive growth to meet demand, it remains daunting to see how the industry can fulfill the demand for service without the ability to lower cost and improve service. The majority of Seniors needing care will not arrive with several hundred thousand dollars to finance their stay or several children to provide home care. Americans seeking to care for their aging parents will expect, and will gravitate to, operators and services using IoT technology as an integral part of the service offering. Senior Care professionals that do not embrace IoT technology as table stakes for the future can expect to suffer the market consequence of ignoring this technology mega-trend.

Conclusion

Smart Home and Industrial IoT technologies are currently capable of providing beneficial features for the growing need for Senior Care. It's not yet clear which solutions will ultimately emerge as the most successful but a clear opportunity for MSO growth is IoT Technology for Senior Care.

[i] US. Census Bureau
[ii] D'Vera Cohen, Jeffrey Passel, Pew Research Fact Tank, updated April 5, 2018
[iii] Institute on Aging, https://www.ioaging.org/aging-in-america#womanliving