SCTE•ISBE CABLE-TEC EXPO® 2020
VIRTUAL EXPERIENCE » OCTOBER 12-15

2020 Fall Technical Forum
SCTE·ISBE • NCTA • CABLELABS®

The Business Case for Aging in Place with Cable Operators

A Technical Paper prepared for SCTE•ISBE by

Ian Wheelock
Engineering Fellow
CommScope
Ian.wheelock@comscope.com

Charles Cheevers
CTO Home Network Solutions
CommScope
Charles.cheevers@comscope.com

Dr. Sudheer Dharanikota
Managing Director
Duke Tech Solutions Inc.
111 Fieldbrook Ct., Cary, NC 27519
+1-(919)-961-6175
sudheer@duketechsolutions.com

Ayarah Dharanikota
Business Analyst
Duke Tech Solutions Inc.
111 Fieldbrook Ct., Cary, NC 27519
+1-(919)-376-5657
ayarah.dharanikota@duketechsolutions.com

Table of Contents

List of Figures

1. Introduction

2020 has been a landmark year for the human race. Never before has the human race been equipped with the technical capability to be able to handle dissecting data as well as innovation in finding cures and prevention to something like the coronavirus strains that now threaten the fabric of how we behave as a society. We are all locked in our homes and trusted areas of interaction with our fellow humans. No sector of the human race has been more affected by the pandemic than the elderly population. The virus itself affects those with compromised or weaker immune systems more often than not. This not only brings our elderly population into the most vulnerable group but also now making elderly care homes possibly the most likely place to catch and spread a virus and contagion.

Even before our pandemic times, it was clear that Aging in Place (AIP) was a key area for new opportunities for Cable Operators to tap into. It's not only a huge improvement change for elderly lives but also a new source of high margin revenue for the Cable Operators. Lockdown at home has given everyone a taste of what it is like spending more time in your home and in particular the role of connectivity in our digital work and social lives. One could almost claim that the foundation pillar of AIP is connectivity. Thus making it obvious that the Service Provider is in a unique position to open up the floodgates on a new defacto model for living out your life in your own home.

Now is the time for Cable Operators to go beyond the triple play and quadruple-play and add high-value connectivity-based services for the AIP cycle of the connected home life. The following sections of this paper will take the reader through the opportunity and some of the key tenets of a Cable Operator led AIP solution. It will also hopefully open up discussion on the key decision points and also the inertia elements for the operator to pivot into this space. This paper will focus specifically on AIP at home rather than in dedicated living communities which can share a lot of the technology and approaches similar to normal residential housing AIP. It will also highlight the simple approach to AIP with the simple tenets of:

- Technology assist for aging in place
- Connectivity
- Communication
- Data Analytics

With a practical focus on the simple assists for Aging in Place, the Cable Operator can do well in the high-value service that will emerge to keep people at home longer.

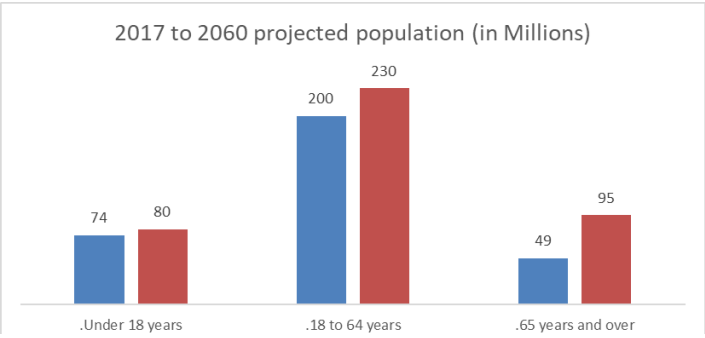


Figure 1 US Census 2017 - 2060 population projection

2. Understanding the Aging in Place market opportunity

US aging population percentage is growing. Based on[1] the US Census, as shown in Figure 1, the aging population that is above 65 years old, is nearly going to double from 49M in 2017 to 95M in 2060. This is attributed to the reduction in mortality rate. This growing elderly population is going to significantly increase healthcare and in general, their lifestyle-related spending.

[1] United States Census Bureau, *2017 National Population Projections Tables: Main Series*, available here

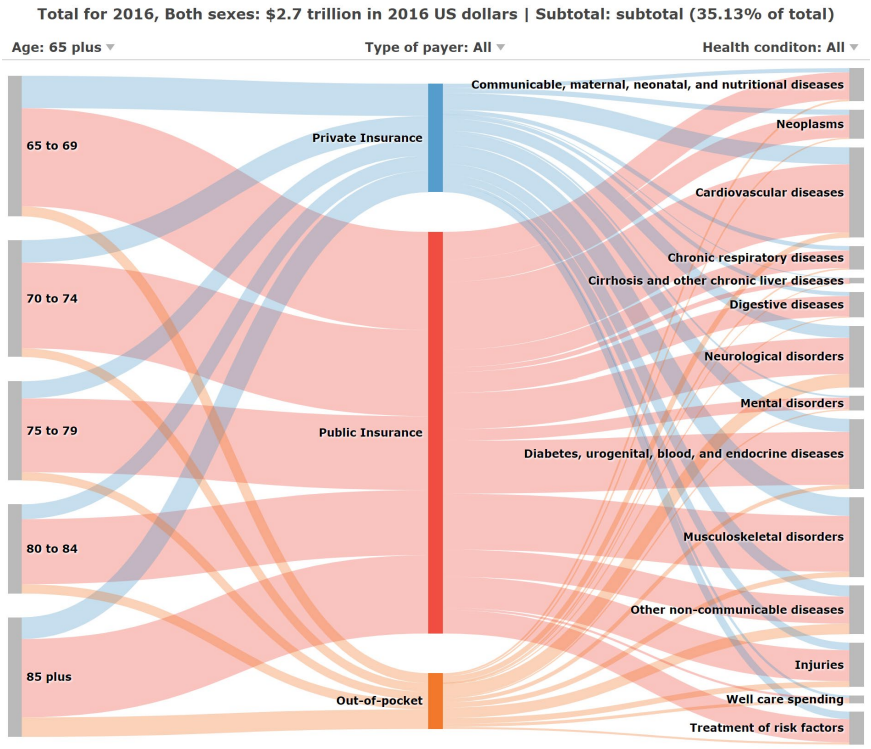


Figure 2 2016 healthcare spend from elderly based on their insurance and condition

As shown in Figure 2 from VizHub[2] Out of $2.7Trillion spent on healthcare in 2016 in the US, ~35% is spent on the above 65 years age group. This amounts to ~$1Trillion on the needs of an aging population. Based on the yearly healthcare cost allocation from National Health Accounts[3] the overall healthcare spending reached $3.6Trillion in 2018. If the same trend continues, by the year 2028, the US will be spending ~$1.6T on the elderly population (as presented in the insert *2018 & 2028 US Healthcare Spend and Highlevel AIP Opportunity*). This is the basic spend on the elderly with the status quo of support. Through innovations, different industries are trying to address the needs of the elderly. Some of these healthcare spendings can be used for their lifestyle changes that potentially can reduce the overall cost.

The aging population will be more technical savvy ➔ Open to newer business models

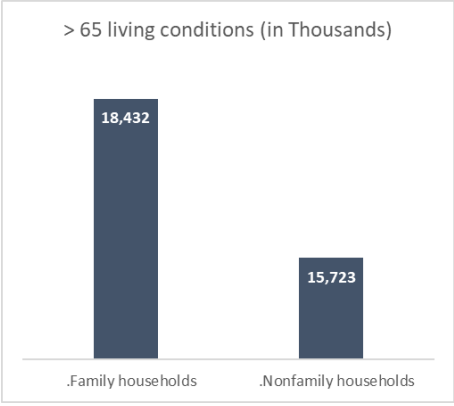


Figure 3 2019 elderly living by census.gov

The 65-year-old today entering their AIP journey is more technically savvy and has lived most of their life with the Internet (introduced 30 years back), laptops (30 yrs.), smartphones (13 yrs.), and devices such as Alexa (6 yrs.). So, the 65-year-old today is in reasonable shape to leverage and drive technology themselves for their AIP independence. The 85-year-old today in their AIP journey has probably struggled in their use of technology having missed the key events above as part of their working and earlier life. The tech-savviness along with the serious inclinations to staying independent, as shown in Figure 3, 42.1% amounting to 14.4M[4] households (Not including elders couples that are living alone themself) in the US fall into this target market. Historically the homes are growing at 1.013 times year over year. This will lead to roughly 16M homes passed by 2028. This is expected to grow to ~30M by 2060. Like any solution a

[2] *Tracking personal health care spending in the US | Viz Hub*, availabe here
[3] *National Health Expenditures 2018 Highlights*, available here
[4] United States Census Bureau, *The Older Population in the United States: 2019*, available here

connectivity and technological-based solution to help people remain in their homes as long as possible targets the majority of people who follow the pyramid sections, as shown in Figure 4, below where the person can remain in their home with technical support even to the point where they need regular help from external sources and even if they need full-time nursing care. For issues of the mind and brain and Chronic health conditions, these typically have to be handled in

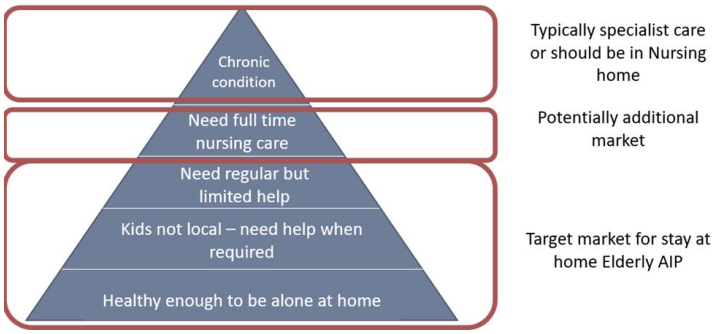


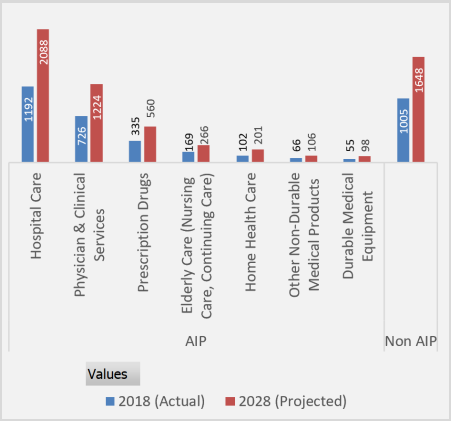
Figure 4 Targeted elderly population who prefer to age in place

Nursing homes or specialized assisted living communities with onside medical resources.

For this Market research analysis we can make some coarse assumptions to develop a best-case opportunity size, as follows:

> Assuming in 2020 ~25% of those 65+ living on their own currently need the help of technology (such as for their self-care, Independent living, and Ambulatory problems) to improve quality of life and the ability to remain at home, the target customer base would be ~14M people. By 2060 this will reach ~24M. 25% of the 14M can immediately benefit from technology assist solutions.
>
> In 2020 about 8% of the population on a Cable Operators network are over 65 and of this about 25% are living on their own. So a *hypothetical operator with 2M subscribers* has an addressable market of 160K subs above 65 of which 45K are living on their own, which will increase to 75K by 2060. This group will be the most motivated to adopt based on the price points compared to the assisted living options.

2018 & 2028 US Healthcare Spend and Highlevel AIP Opportunity



NHE[3] provides a detailed breakdown of healthcare actual send of $3.65T in 2018 and a projected spend of $6.2T by 2028, as presented above (numbers are in billions). Out of this overall spend $2.6T in 2018 and $4.5T can be addressed by the initiatives that are part of the Aging In Place initiatives. Note that this opportunity sizing includes all age groups. If we assume 35% of this is spent on the elderly (as shown in Figure 2), it would be approximately $1T in 2018 growing up to $1.6T by 2028.

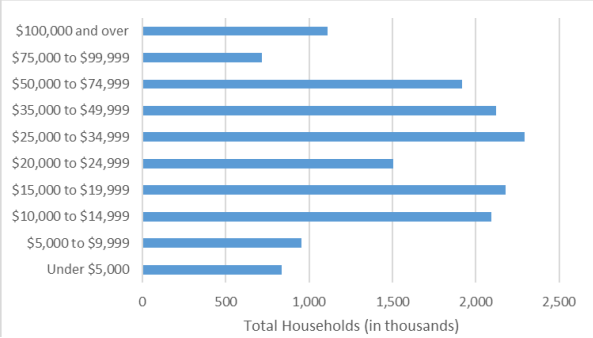


Figure 5 Yearly income, in 2018, of Aging in Place individuals

Now let us see if we can figure out some potential indicators as to how much people are willing to pay, should pay, or can pay for AIP based technology solutions. As shown in Figure 5, the non-family households (representative of the Aging in Place individuals) income is skewed towards less than $50K per year[4]. People age 80 and over who live alone had a median income of $22K in 2018 compared to $52K for married couples.

One out of five older adults have income from earnings. In 2018, the median income of the four-fifths of people age 65 and older who are fully retired was $20,440. The amounts were similar among all older age groups. The monthly income, with no earnings, is about $1,700 so you will see that all of the monthly costs of care are more than the earnings of a lot of the US senior citizens. 2017 Social Security Bulletin[5] report that roughly half of the aged population live in households that receive at least 50 percent of total family income from Social Security and about one-quarter of the aged live in households that receive at least 90 percent of family income from Social Security. In 2018, the yearly average assisted living cost[6] is $45K ranging from $36K minimum in South Carolina to $72K in Delaware. Nursing home costs run from average in 2019 annually of $89K for a semi-private room to $100K for a private room. Things have increased since 2016 and are still increasing as the aging population competes for Nursing Home beds and are on track for 2028 to be $120K for a semi-private

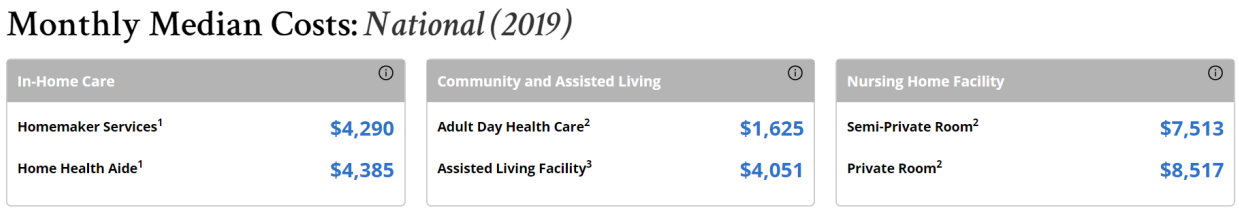


Figure 6 2019 US monthly median cost of elderly care solutions

nursing home room to $135K for a private room. As usual, things vary by state from the highest Alaska at $29K for a private room to the lowest Oklahoma at $5K per month. The 2019 Monthly median cost for care in each of the categories of In Homecare, Community and Assisted Living, and Nursing home care are presented in Figure 6. These numbers don't show the additional costs for memory care or for severe disabilities which are much more expensive. Traditional home health care aides assist seniors with daily activities of living, light housekeeping, offer medication reminders, and serve as companions. Their wages average $20.50 per hour, $164 per day, $5K per month, and $59K annually. *It is this cost and service that we are targeting for technology assist care to minimize the number of hours, days of in-home services, or aides to help.* Skilled nursing care typically involves services similar to home health aides, but providers are trained and certified nurses or therapists who are able to offer additional care such as medication administration, wound and injury care, and various types of therapy. Skilled care averages $220 daily, $6.6K monthly, and approximately $79K per year. *We also want to try and use technology to*

[5] *The Importance of Social Security Benefits to the Income of the Aged Population*, available here
[6] *Nursing Home Costs*, available here

minimize the visits and hours spent in the home of the home health aides and other medical support. GoInvo[7] estimated in 2019 that ~$252B of $3.5T total healthcare costs are spent in Home Health Care and Nursing Care. Compare this with the combined revenue of all US Cable Companies of $83B in 2018.

A couple of other discussion points to consider when understanding the Aging in Place dilemma. In particular the role of family careers for both elderly and in particular single elderly parents. Some of the key premises of *aging in place business opportunities with technology solutions are to enable the parent's children and relatives to provide a more effective caring solution* for not only their parent(s) but themselves. The problem of children caring for their parents is a complex one and has many parameters from

- different cultural views of living with parents
- the stress and business of the lives with their own kids – not having enough time for their parents
- the hassle factor of looking after their parents vs it being a vocation to do it
- the guilt of kids not doing enough for their parents
- the guilt on parents having to rely on their kids for support
- the economics for care – if the parent(s) can't afford, can the kids pay for the Help services
- Proximity and closeness of the kids or family members to the Aging in Place parent(s)

[7] GoInvo, *Where your health dollars go*, available here

And lots of other factors that many readers will be familiar with the 2020 AARP report[8] provides a very detailed analysis of the impacts on the extended family due to elderly caregiving. They found that more than 1 in 5 Americans (21.3 percent) are caregivers, having provided care to an adult or child with special needs at some time in the past 12 months. As shown in Figure 7, This totals an estimated 53.0 million adults in the United States, up from the estimated 43.5 million caregivers in 2015. When looking at caregivers for adults only, the prevalence of caregiving has risen from 16.6 percent in 2015 to 19.2 percent in 2020. They also highlight "*Unpaid caregiving is increasing in prevalence and the U.S. population continues to age and live longer with more complex and chronic conditions. Caregivers feel the push and pull of providing care on their time, their financial well-being, their health, their family, their work, and their own personal well-being. They may find themselves in need of information, resources, benefits, or programs—but these things are often difficult to find or access, or too expensive to afford. Unpaid caregivers are serving as a core piece of the health and long-term services and supports (LTSS) systems, as well as the main source for long-term care for adults living at home and in the community.*"

A note on taxation and Medicare coverage for Aing in Place

In most cases out of pocket nursing home costs are generally tax deductible under itemized medical expenses. If yourself, your parent, spouse or another legitimate dependent is in nursing care primarily for medical care, then expenses related to medical care, lodging and meals are deductible. However, seniors in nursing homes for personal reasons rather than medical, will only be allowed to deduct costs associated with actual medical care, but not meals and boarding costs. Medicare will cover skilled nursing care expenses in very specific situations and is not designed to pay for nursing home or custodial care costs long term. One such situation is when a senior has been hospitalized and released, but still requires a bit of specialized care. Medicare will help pay for short terms stays in nursing homes if they:

- Were admitted to the hospital for a minimum of three days as an inpatient
- Have been admitted to a Medicare certified facility within 30 days of the hospital stay
- Need skilled care like physical therapy, speech therapy, and other types of rehabilitation

Those who meet all of these conditions under original Medicare will qualify for assistance as follows:

- Up to 20 days of nursing care is 100% covered by Medicare
- After day 21 and up to day 100, patients will pay a co-pay that averages $170.50.
- After 100 days, all Medicare coverage ends and all payments are the patient's responsibility.

Medicaid Coverage for Nursing Home Care.This coverage assists individuals with many types of medical care including doctors visits, hospital stays and long-term care services such as those received in a skilled nursing facility. Often, this program covers 100% of these costs, but there may be co-payments for certain beneficiaries. For those who qualify for Medicaid, this is the best choice for nursing care coverage. Your Home does not count against Medicaid if someone else is living there or its less thant $595,000 (or $893,000 in some states). Medicaid may put a lien on your house to cover expenses on your death.

-

[8] AARP, *Caregiving in the US*, available here

	2020 Prevalence	Estimated Number of U.S. Adults Who Are Caregivers	2015 Prevalence	Estimated Number of U.S. Adults Who Are Caregivers
Overall	21.3%*	53.0 million	18.2%	43.5 million
Caregivers of recipients ages 0–17*	5.7%*	14.1 million	4.3%	10.2 million
Caregivers of recipients ages 18+	19.2%	47.9 million	16.6%	39.8 million
Caregivers of recipients ages 18–49	2.5%*	6.1 million	2.3%	5.6 million
Caregivers of recipients ages 50+	16.8%	41.8 million	14.3%	34.2 million

** Significantly higher than in 2015.*

Figure 7 Prevalnce of caregiving by age of recepient, 2020 compared to 2015 from AARP

As shown in Figure 8, family caregivers[8] spend ~24 hours per week on their loved ones while 21% of caregivers are providing 41+ hours of care. The solution potential is to appeal to these family caregivers to give them the tools to have a more balanced life themselves and be able to use technology to be able to decrease the amount of active time that they spend with the parent(s) they are providing care.

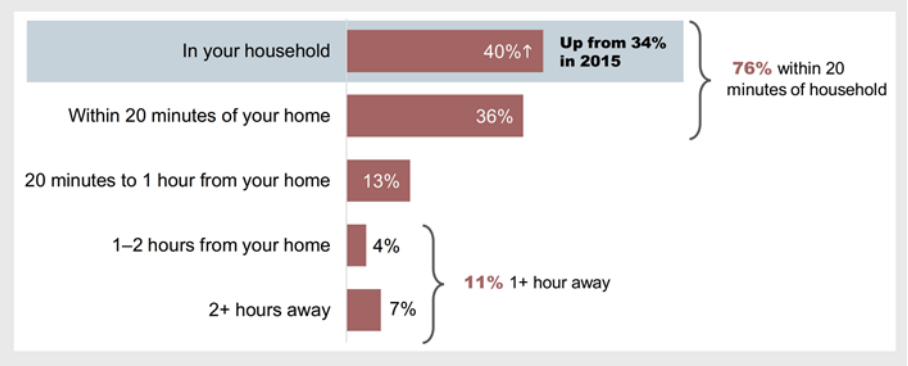


Figure 8 Average number of hours per week spent by caregivers (from AARP)

AARP analysis[8] also identified that, as shown in Figure 9, ~76% of the caregivers are within 20 mins from the care recipient and ~11% of them are more than an hour away. This also provides a good case for the monitoring solutions that can be offered for the AIP population.

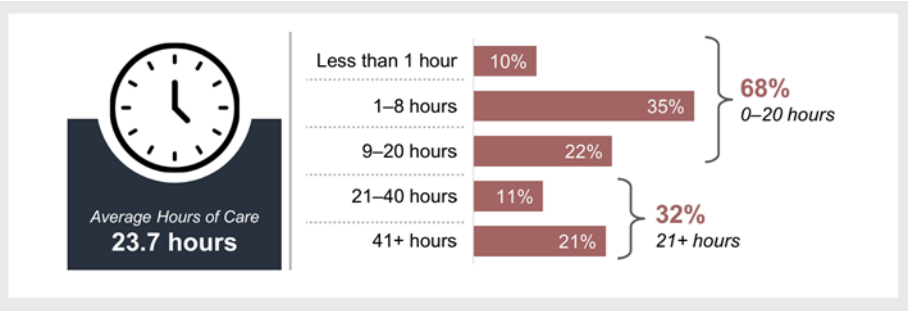


Figure 9 Caregiver distance from Care Recipient (from AARP)

As shown in Figure 7, an estimated 40M Americans are providing care for older members of their family. These family careers often have severe impacts[8] on their own careers, finances, and ability to also save for their retirement and healthcare. *The technology solutions suggested here in this paper would offer many of these careers more time and the use of technology to be more efficient with their face to face time with their elder parents and in many cases remain remote for their parents for a lot longer in the Aging in place lifecycle.* Some of the aging population needs are well articulated in the National Science and

Technology Council report[9] as extracted into the insert *"Emerging technologies to support an aging population"* below.

Emerging technologies to support an aging population

This report identifies a range of emerging technologies that have significant potential to assist older adults, and it is offered as a guide for both public and private sector research and development (R&D) *to improve the quality of life, enhance individual choice, reduce caregiver stress, and cut healthcare costs*. The Task Force identified six primary functional capabilities as being critical to individuals who wish to maintain their independence as they age and for which technology may have a positive impact.

1.Key Activities of Independent Living. Living independently requires the ability to perform of a range of activities that impact our daily lives. Many of these activities can be assisted through technology, including those that support good nutrition, hygiene, and medication management.

2.Cognition. Cognitive changes are common during aging, with increasing prevalence at older ages—varying in severity and impact. These changes can affect the ability to live independently as well as personal safety. Technology holds the promise to help older adults monitor changes in their cognition, provide mental training to reduce the impact of these changes, and create systems that assist individuals and families to maintain financial security.

3.Communication and Social Connectivity. Older adults may face communication challenges as the result of hearing loss, social isolation, and loneliness, especially in economically distressed and rural communities. Technology can improve hearing and strengthen connections to larger communities.

4.Personal Mobility. Mobility is a key factor in successful aging. To live independently, an individual must have the ability to comfortably and safely move around the home and throughout the larger community. Technology can assist older adults in staying mobile and able to safely perform key activities necessary for day-to-day life as well as interact with their communities.

5.Transportation. True independence requires mobility outside of the home and neighborhood. Transportation needs and limitations are dictated to an extent by the changes to individual physical and cognitive abilities that come with age. While some older adults remain completely independent and continue to drive without assistance, others may be able to drive but require vehicle modification and/or advanced technologies to assist them while operating a vehicle. New technologies could also help older adults more safely and easily use public transportation.

6.Access to Healthcare. Access to healthcare plays a critical role in helping older adults stay active and independent as they age. Activities and strategies that support the maintenance of function and independence with age are multifaceted. Alignment and coordination of these efforts through technology can increase the effectiveness and efficiency of these services.

In the process of identifying primary capabilities and focus areas in which technological advances can have a positive impact in enabling older adults to age in place, several areas emerged that are associated with a number of technological solutions and were therefore not specific to individual R&D recommendations. These areas are included in the final section of the report, **Cross-Cutting Themes**.

[9] Committee on Technology of the National Science and Technology Council, *Emerging technologies to support an aging population,* March 2019, available here.

As shown above, significant work is in progress to address the aging population needs and one of the top priorities is to provide this to reduce the overall healthcare costs. It is also intuitively understood that aging in place will provide significant cost savings. Note that these costs are not all related to healthcare alone, as explained in the insert *"Emerging technologies to support an aging population"*. Some of the technological areas aging population require assistance is highlighted in Figure 10. Although this gives the depth and breadth of the needs for the aging population, the stepping stone for this is an **AIP Home**. The rest of the paper we focus on this application noting that the opportunity for the Cable operators is a lot more than what is covered in this paper.

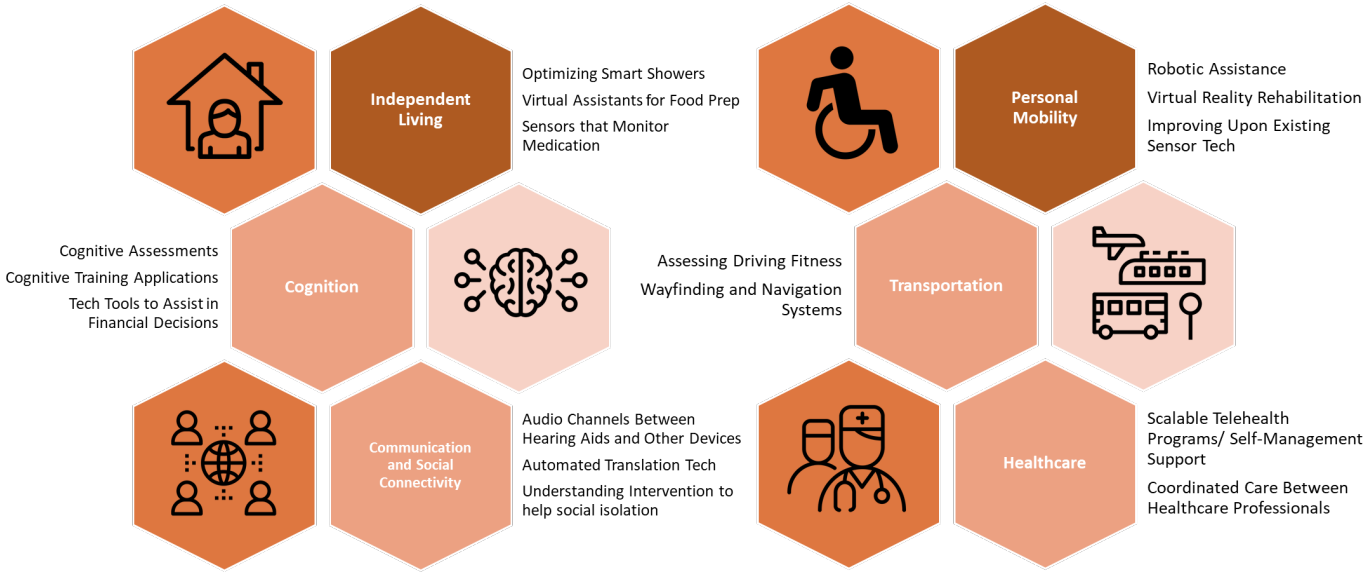


Figure 10 Some of the example technological soutions required for the aging population

As a first step to the business case, let us understand the current costs or payments by the elderly population. Then analyze this against the target population who can adapt to the elderly-friendly smart homes. In later sections, we analyze some of the solutions, as low hanging fruits, that Cable operators can offer to reduce the health care costs and its potential revenue opportunities.

Figure 6 provides the cost of the elderly population in different stages of support. The following discussion will outline different opportunities for the Cable operators -

- Provide a preventative/pre-emptive technology solution to the 55M maximum elderly homes
- Out of which 3.5M homes that can potentially use the solutions now with specific packages
    - This opportunity is going to grow to ~6M by 2050 based on population growth estimates
- Offer the technical solutions to reduce the human support for in-home care support costs
- Offer solutions to prolong the need for Assisted Living through different technical solutions
- Offer solutions to enable in-home nursing through technologies rather than Nursing Homes

Before we leave the business case roll up it is also important to consider the cost of insurance typically paid for the Aging in Place journey of your life. Fidelity Insurance[10] estimates that the average US Citizen is going to need $285K to cover the costs of Health in retirement. Annuity.org[11] shows that an 85-year-

[10] Fidelity Insurance, *How to plan for rising health care costs,* August 2020, available here
[11] Annuity.org, *Health care costs in retirement,* 2019 survey, available here

old couple in 2039 is likely to be spending $34K on their Health Care costs not inclusive of Long Term Care specific costs.

There are many healthcare costs related to technical challenges that can be addressed in an *AIP home*. Note that healthcare is only a small portion of the AIP needs (as highlighted in the *Emerging technologies support for AIP insert*). For example, technology can help with,

- Maintaining contact with family and neighbors to avoid loneliness and depression
- Minimizing the likelihood of accidents and issues in the home
- Getting to someone quickly when falls or other medical issues happen
- (Possibly) Following doctors' orders on diet and medication

A simple representation of some of the technology services that could be implemented to curtail physiological, medical issues as well as improve help time and quality of life for those with deterioration in being able to look after themselves. Figure 11 shows some of the technological services that can be offered to the aging in place population.

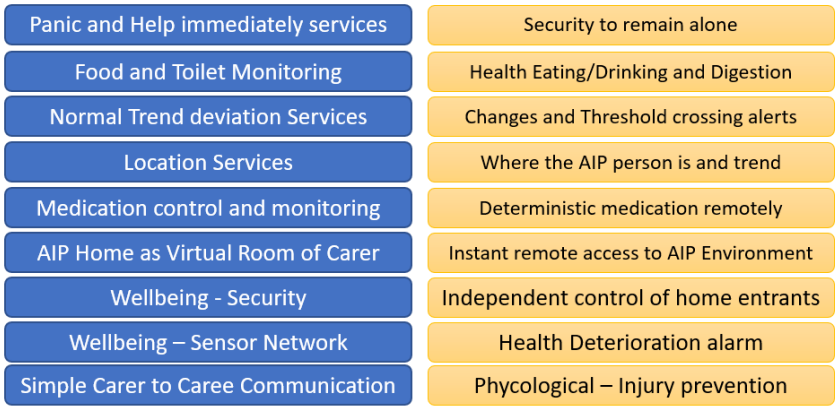


Figure 11 Simple technology solutions that can assist aging in place

HIPAA considerations: Medical information is protected by HIPAA[12] (Health Insurance Portability and Accountability Act) Patient Health Information (PHI) handling rules. It is important to stress that the Cable Operator offers service to an *AIP Home* and the person is **NOT** to be a medical service provider. ~~-or potentially not even to perform the functions of a Care Portal (Where any telemetry from the AIP Home is stored).~~ It is worth exploring this more as one of the main questions in the business case for Aging in Place - the liability and responsibility of Cable operators in *AIP Home* service. The collection of telemetry from the Aging in Place home that collates to provide services to the AIP person is the activity we are targeting for the Cable Operator opportunity. The information in the telemetry can be wide-ranging from –

- Non-PHI related AIP application activities - watching TV, motion derived from Wi-Fi detection
- PHI related information like the collection of BLE based health sensors - thermometers, pulse oximeters, blood pressure cuff
- Not so certain PHI information which on its own is not medical information but can be used to derive health issues and is not subject to HIPAA PHI on its own
  - the collection of other sensors BLE, ZigBee, Wi-Fi, Z-wave, others that perform other detection sensory functions (room presence, door open/close, fridge open/close, pillbox opened/closed)
  - the use of cameras for visible monitoring and internal home transparency to approved carers

[12] HHS.gov, *Guidance Regarding Methods for De-identification of Protected Health Information in Accordance with the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule*, Nov 2012, available here

  - the use of audio devices to detect cries for help
  - the use of panic buttons for emergency help solutions
- Highly PHI associated information such as the specialist internet-connected home medical equipment ranging from pill dispensers to chronic illness support like cloud-controlled and monitored dialysis machines.

These all have varying degrees of issues with privacy, reliability, a consequence of correctness. It is envisaged that most Cable Operators will not provide the AIP care portal solution (for the purposes of this paper's scope – think of it as the interim database of the parametric information collected from the AIP home to perform the AIP service. This database and API interfaces are subject to the rules of privacy for both home and medical (if recorded) information). As shown in Figure 12, the cable operator can use two simple mapping models.

(Model 1) Cable Operator provides **only** a connectivity solution and a set of cloud services to the AIP solution and AIP care portal – forwarding AIP telemetry in a pass-through model to Healthcare Delivery Organizations (HDO's). The client solutions in the AIP solution set are typically supplied by the AIP portal company and in many ways are anonymized to the Cable Operator who may only provide a certain hub and display and audiovisual help services – driven by API's that can be accessed by the AIP solution provider. This access to this cloud, App, and API services can be a 'charge for' service – particularly gaining access to Operator provided device resources in the home. HIPAA compliance is a wide-ranging area which we will outline briefly later in the paper but this solution offering works to abstract the Cable Operator as much as possible from any HIPAA compliance requirements. With the increase in privacy requirements for every Cable Operator and consumer engagement, Cable Operators are already becoming familiar with the security and privacy of data and have implemented solutions themselves and with vendors like CommScope and others to ensure compliance to privacy and security. In this architecture, the Cable Operator provides a business service to

- AIP Care Portal companies who make the compliant linkages to AIP homes and the AIP resources that need to help them like Care Companies and Medical support
- Collects a fee from - AIP person or carers, selected Care Company service provider – allowing them access IoT Hubs, Displays, another home telemetry including voice and audio services.

(Model 2) An argument could be made that the Cable Operator could actually perform the Care Portal function explicitly as an extension of its own Home telemetry databases. The Cable Operator already performs smart home and IoT functions and many of these functions overlap with the same schemes for AIP solutions where some of the IoT devices are recording health information. The Cable Operator can provide the necessary security, privacy, and anonymization features to the northbound AIP resources including medical analysis services. In this scenario, the Cable Operator could expand its Smart Home or Security services to cover some of the functions of response to AIP issues and response requirements. The Cable Company could also partner with AIP solution providers to give them access to their Care Portal solution as part of their service. The Cable Operator would take a percentage of the direct to AIP person service charges for the use of its Aging in Place Care Portal and in-home devices and telemetry services.

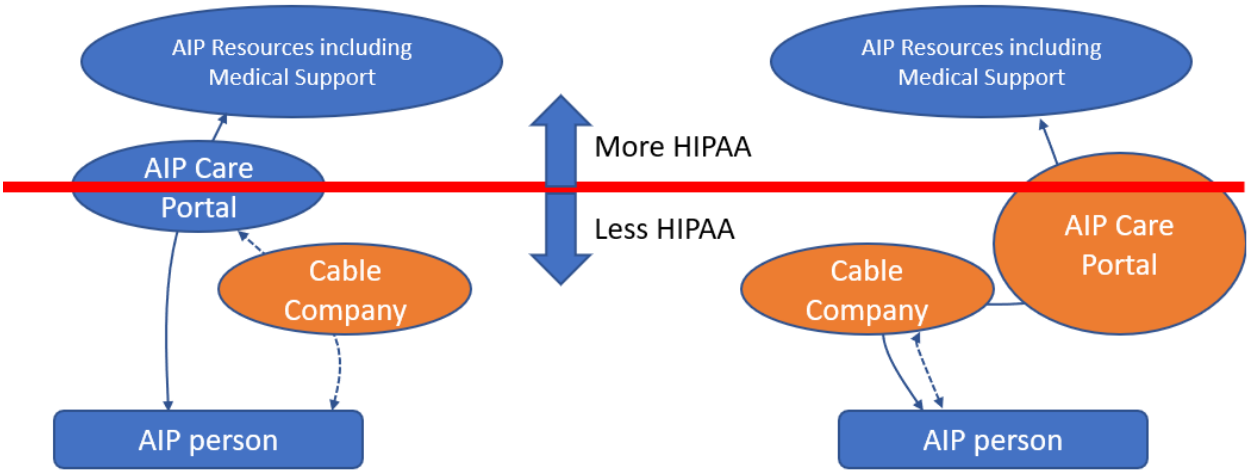


Figure 12 The two potential solution architectures for AIP services from Cable Operator

Expanding on the issues around liability and having now introduced the HIPAA and PHI words let us spend a few minutes and discuss some of the key areas that typically come up when discussing Health over Cable solutions

- Medical Liability when offering services that can be tagged as pulling health or medical information from the home or devices
- Offering emergency alert solutions like panic buttons and not fulfilling SLA with consumers on the reliability of emergency alert solutions.

As stated earlier – the goal of the Cable Operator Aging in Place solution is to pick the solution set to **minimize** any interpretation or prognosis of medical data and to align an AIP solution more with the Home Security offerings of the Cable Operator – where the key issues are reliability of connection to the cloud – and the ability to hand off the telemetry information to the Security service provider and call-out services.

HIPAA (Health Insurance Portability and Accountability Act) is a broad-ranging Act but the key element of it for AIP solutions is to adhere to the HIPAA privacy regulations and provide the defined protection and confidential handling of health information. The National Institute of Standards and Technology (NIST) and the National Cybersecurity Center of Excellence (NCCoE) have been defining standards to make sure that medical devices cannot be compromised, and privacy standards are maintained. There is a new term used on the Internet of Medical Things (IoMT). There are probably two basic levels of worry of exposure

- Informational leaks about the individual's medical conditions, health status, changes in health etc.
- Unauthorized, incorrect, or illegal changes in any medical parameters or status that can inadvertently affect the person or are illegal. This particularly applies to any AIP solutions that have changes made in the conditions in the home like
    - Changes in recommendations for medication dosage via reminders or other technology assists
    - Changes in chemical mixes in sophisticated medical devices like infusion pump based delivery systems.

To reemphasize, the cable operator approach to Aging in Place solutions will be to provide the best possible solution to minimize exposure to the deeper medical elements which will typically be offered by partnered solution and the key thing for the Cable Operator solution will be to leverage

- Devices and Hubs to connect to overlaid AIP devices
- Provide reliability of connectivity service
- Provide an AIP Consumer Experience in its own Consumer Experience across its ownership of devices like a TV screen
- Leverage its non-PHI telemetry to create economic telemetry streams when correlated with AIP devices strengthens the Cable Operator value in the AIP value chain

A typical reference architecture for Aging in Place and intervention Telemedicine is shown Figure 13.

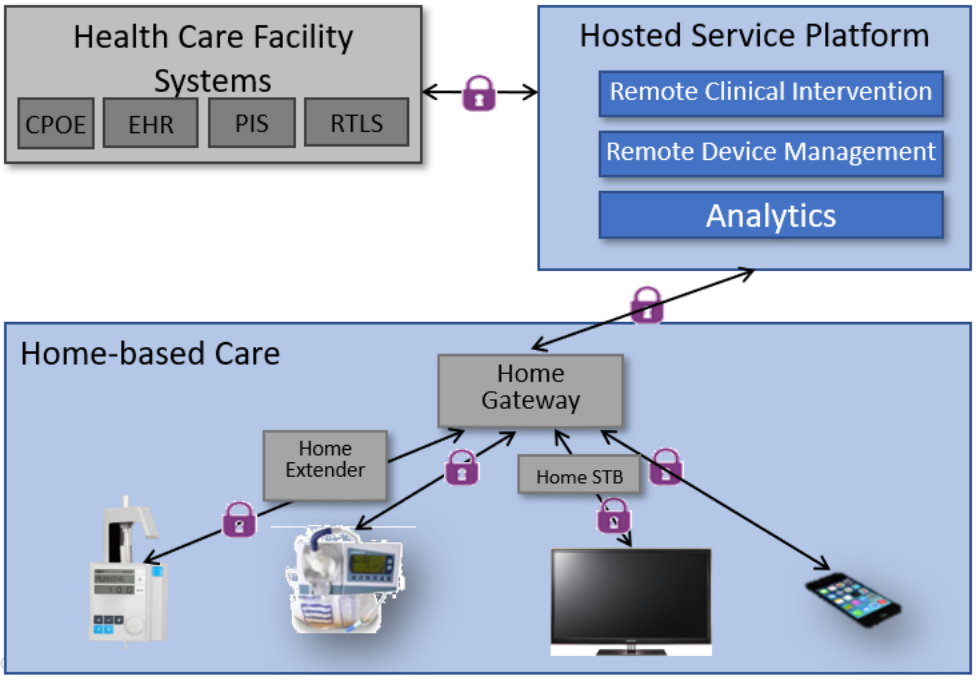


Figure 13 Potential 3-way solution set for Aging in Place and Medical intervention

A more detailed but simple illustration of the AIP value process for the Cable Operator architecture in AIP is illustrated in Figure 14. Whatever path the Cable Operator goes in the value chain of Aging in Place they are positioned well to be able to offer the service or partnered services through their

- Ability to market services into the 65+ bracket homes they provide broadband and video services
- Ability to market to the kids and caregivers of an elderly parent(s) who are also in their network
- Potentially also collaborate with each other on AIP services across different partnered Operator Networks. This is the case where the AIP home is in for example Mediacom's network and the Kids and Carers are remote on a Comcast network.

It is this ability to market, fulfil and support the service as well as the integration of the solution into the Connectivity and Video offering (detailed later) that drives a strong case for the Cable Operator to insert in the value chain of Aging in Place.

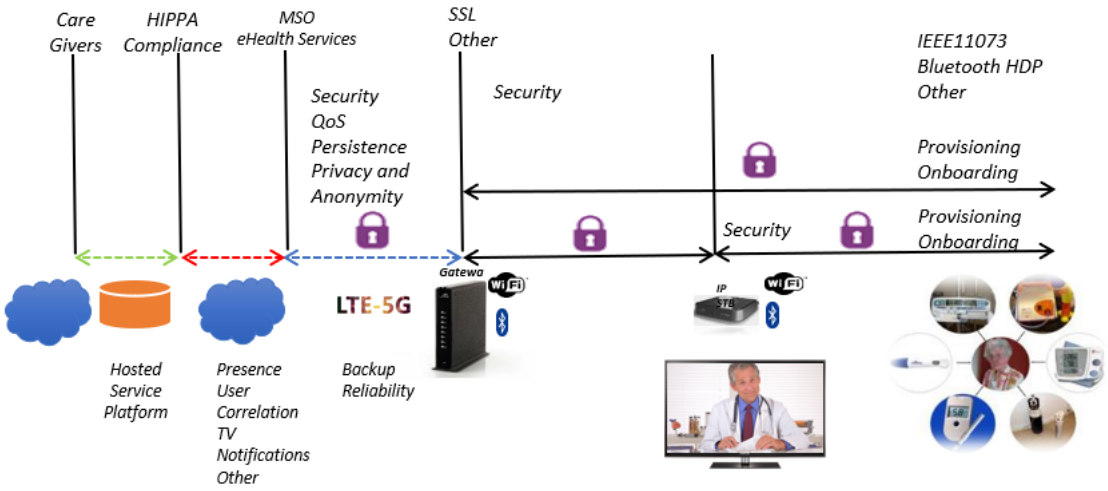


Figure 14 Key Elements of the Connectivity Solutions for Cable Operators in AIP value chain

3. Connectivity a major element of the Aging in Place solution

Now, let's start to develop the pillars for the Technology solution and Connectivity solution offerings that the Cable Operator can offer to the Aging in Place home on its network.

The key is using the broadband connectivity provided by the Cable Operator to form the basis of the AIP solution. As shown in Figure 15, the 65+ group is one of the demographics with the lowest internet connections and in 2020 it is ~80% of the population. As part of technology based AIP solutions, there will need to be some new additional connections and the new costs introduced for broadband services. Cable Companies should consider some new reduced rate services for these initial connect applications to onboard the AIP home and then grow the value of the connectivity with the payers of the home connection.

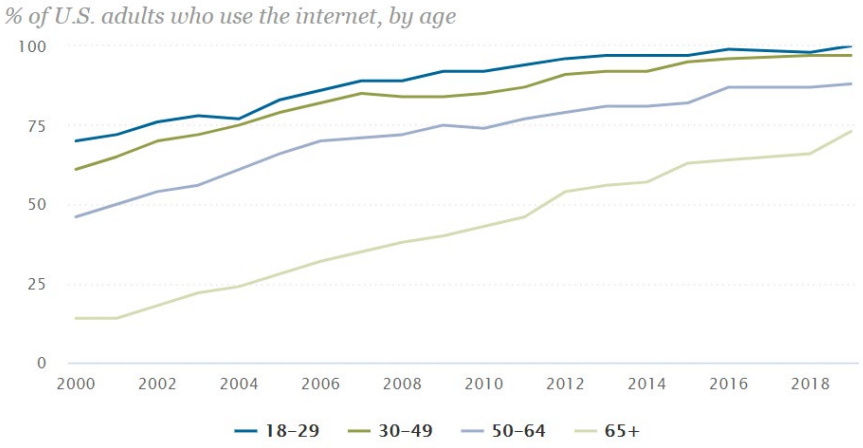


Figure 15 US - 2000-2019 Adults connected to the Internet by age

One additional point of note is that there are many people who are for connection to elderly people using technology tools themselves for communication and in some cases do-it-yourself monitoring and even more advanced health-based monitoring solutions. These solutions typically comprise of – video conferencing capable phones (Apple Facetime, Google Duo) for visual contact, smart speakers (Alexa Dot and Show, Facebook portal, Google mini, Google Next Hub), solutions like Alexa Drop-In – which allows an incoming call to be answered without the user having to pick up, emergency alert pendants, cameras,

some sensors for movement etc. But typically they are not going beyond this small subset of solutions into more complex and linked monitoring and activity promoting solutions.

However, it should serve to highlight the basic importance of connectivity. To create that connection from remote carer to AIP person and to make the visibility into their current status something that can be checked by simply looking at an application on your phone. This is key also to the business proposition of Aging in Place. To be able to

- Make the carer infrastructure remain remote from the house as long as possible
- Only have the carers in the AIP persons home when they desire or is necessary or scheduled
- Minimize the carer travel cost and optimize the efficiency of the time they spend face to face
- Allow multiple carers to share the burden of care with technology to help them all see the daily life metrics of the Aging in place person and spread the response amongst more than one individual for different activities (Remote carers can take a watch on cameras placed in AIP persons home or monitor alerts to alleviate this burden from carers)
- Allow the AIP person to remain in control of their own care needs through initiating help
- Become independent and remove burden that an AIP person may cause on their family
- Spend wisely by the AIP person or their family carers in covering any AIP costs. This sometimes translates to not spending money on even Internet connectivity for the elderly and certainly slower to invest in technology solutions and Do-It-yourself plans.

The last point 'spend wisely' is an interesting part of the AIP journey and especially when a decline in ability is slow but steady. Our elderly from 65 onwards, are a generation where saving for 'a rainy day' has always been in their minds as well as trying to also leave their kids something to improve their lives. Additionally, when small issues around ease of mobility or getting more chairs bound to creep in, there is not an immediate tendency to start spending money to get help a few times a day to move to different parts of the house. Indeed many or all AIP persons tend to soldier on at tasks that were once simple like dressing in the morning but have gotten much harder due to arthritis or other ailments – and don't think to look for a morning help service until they reach absolute inability to do the task. People and the Elderly with limited and finite resources will not spend money for help until its usually past the time they needed it. *It is this fear of opening the dwindling bank account or running up debts that many times inhibits an AIP person from using $20 per hour to help resources to enable them to keep quality of life and continue to function well in their homes. This can be one of the biggest drivers of creating a Cable Operator connectivity led Aging in Place solution that provides elements that always show the cost efficiencies and return on living at home longer.*

The Figure 16 below illustrates a typical three phase potential decline in the Aging in place process. For most people, the journey starts where you remain independent even if afflicted with some health and mobility issues. Most of the solutions for technical support of AIP rely on sound mind and diseases of the mind while they can be still supported with technology often and most of the time involves rely on heavy personal contacts of carers.

As you can see in this very simplified approach to Aging in Place – the first phase of reasonable health is the 'monitoring phase'. In this phase, connectivity is used to provide remote access for carers to the health of the AIP person and their daily status. *One of the key elements of a Cable Operator Aging in Place offers is to promote the on-ramp of this stage process to the 65-year old that probably feels they don't need this phase of monitoring until it is required which is sometimes too late for the avoidance of issues.* We will discuss some on-ramp options for Cable Operators later in this section– particularly with the monitoring service tied to existing devices the AIP person has in the home for access to internet and video services.

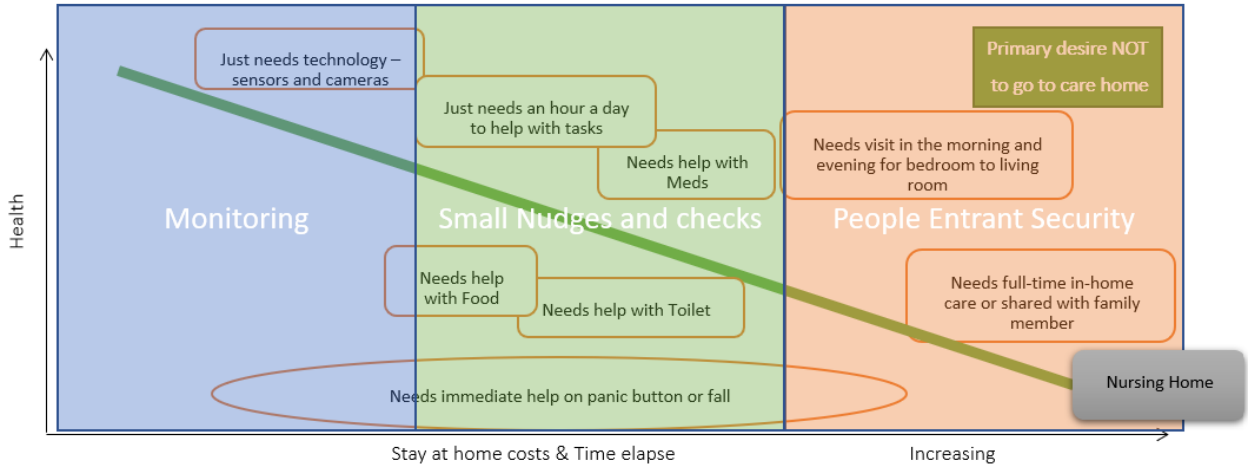


Figure 16 The Simple Phases of Aging in Place decline

Monitoring needs to be clarified before we progress. Monitoring, as shown in Figure 17, has usually two aspects when discussed with Aging in Place solutions

- Family carers monitor a parent or parents who are starting to decline a little or through a period where they have to take medication for improvements – *the focus for Cable Operator solution is probably to define a package and market to this audience.*
- Professional monitoring where any home readings go directly to a Care Portal for professional review with an intermediary (doctor or care company) – *this can be done with business development functions directly to the AIP companies in the area.*

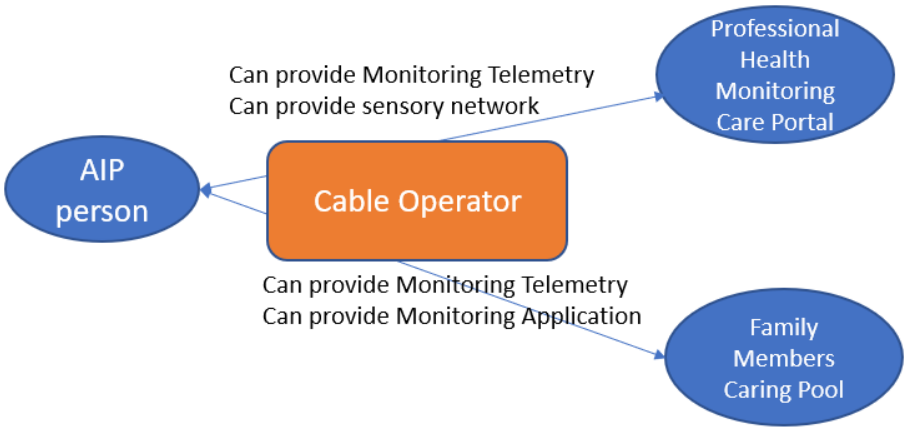


Figure 17 Cable Operator Connectivity can provide the basis for Monitoring Services

There is an opportunity for the Cable Operator to really own the first and to partner with companies who provide the second option. During this monitoring phase – the focus for a connectivity solution is to be simple. There is a simple hierarchy of monitoring all of which can be offered at different prices and levels of sophistication. The first is the availability of the connection catering to different requirements of reliability and price points.

- High Available connection to the home – typically with a Cable/DOCSIS/Wi-Fi first and backup with LTE or 5G NR (which can be pay as you use basis to make it more cost-effective)

- Leveraging the general DOCSIS broadband connection for the majority of all monitoring solutions and typically of high availability. *Solutions can be added to the Cable Operators' own monitoring of their network to immediately alert any AIP monitoring solutions when the DOCSIS network has dropped – allowing the carers to use other methods of contact (direct calls to LTE/5G based phones or get someone to the AIP person).*
- Leveraging the existing device ecosystem in the home to create a convergent solution offering across the Broadband and Video services which offer reuse opportunities for Aging in Place.
- Leverage the increase in deployment of Smart Speaker assistants that support both Audio and Visual feedback and output.
- Leveraging the increase in deployed IoT radios, in particular, BLE which is becoming the key remote control interface to Set Top Box and Smart Media Devices.
- In particular the key use of the connected Smart Media Device as the connected Hub of Aging in Place services.

Bringing back the connectivity architecture, as shown in Figure 14, the key elements of the connectivity chain, ensuring security on the link, ensuring persistence of data sending, ensuring privacy and anonymity, and ensuring simple onboarding and provisioning of AIP devices/services. All based around the key devices of broadband GW and Wi-Fi, and Smart Media Device (with inclusive BLE and Far-Field Voice and Speaker technology).

Much of the AIP service can be served with this simple and for the most part – a normal home device and connectivity ecosystem. *This is key to the Cable Operator business case in that the investment in AIP capital expenditure is aligned with the general capital expenditure for the new Cable Home inclusive of IoT, Smart Assistants, and the migration of the STB to the Smart Media device.* The SMD will be explored in more detail in the next section of the paper as it is the key device and hub to offer the AIP Cable Operator service. The key areas of transparency in the home and ability to capitalize on both the standard Broadband and Video devices are issued and the general IoT devices supplied as part of smart home and security applications. There is a natural sensory network now emerging in the home – with (i) Wi-Fi (ii) BLE (iii) other IoT radios like Zigbee and Zwave (iv) Voice input – that can provide the foundational pillars of Cable Operators Aging in Place hub and interface to partner AIP services.

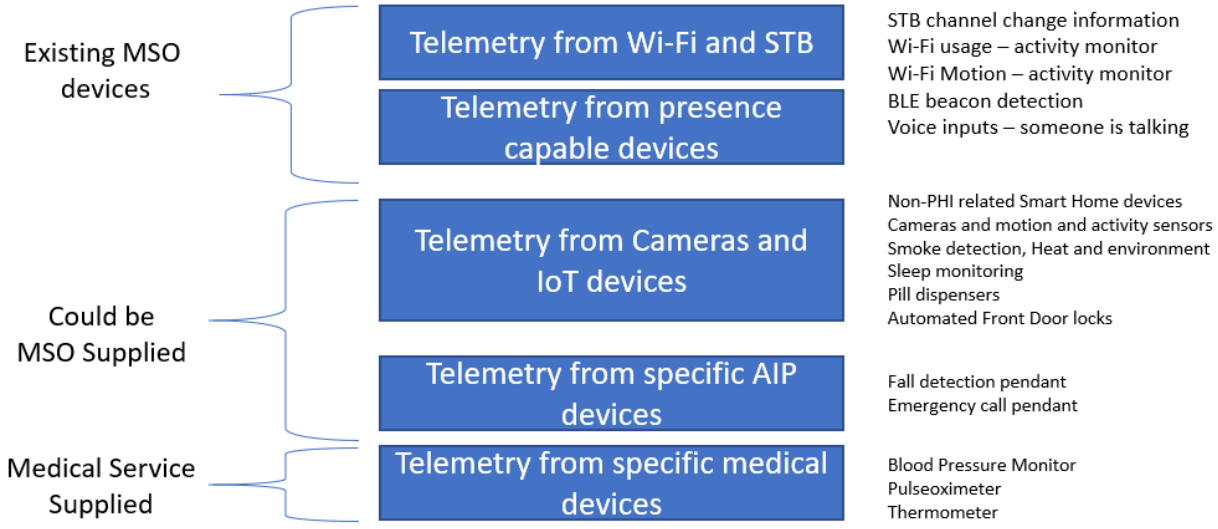


Figure 18 The five classes of device types that make up the AIP telemetry solution

Probably the most important connectivity and monitoring feature is just the ability to easily contact the AIP home remotely but with the following problems that a better solution than just calling them on the phone has to offer

i. **Video Chat** is always better than just voice for better and more personal interaction as well as the psychological benefits of more intimacy. Additional regular video views of the AIP person helps to do visual checks from carers. *Video transparency of the AIP home is probably the #1 fundamental connectivity feature and it alone could be improved to form a basic package to the AIP home*

a. As Elderly people age – the ability to use the Tablet and Smart Phone can diminish. Phones can get lost and require mobility to find them. The use of static Video Conferencing solutions is a key part of the communication reliability to the AIP home. Cable Operator provided Video Conferencing solutions are an important part of the AIP solution. One of the key functions of the evolution of STB to Smart Media device is to support Video Conferencing on a TV – the primary screen that most elderly's spend a large portion of their day and is present in the rooms they occupy most. The TV itself also has the advantage of size and accessibility features for hard of sight and hearing. Even the humble TV remote can also be a more friendly interface device than a complex smartphone.

ii. **Use of Voice as an input to the Aging in Place solution**. The advent of Smart Assistant technology has now found a home as part of the Aging in Place solution. Providing a cheap way to have whole-home coverage of a smart speaker and communication solution but most importantly as a way to be able to offer remote intercom support easily. Being able to reliably contact Mam or Dad when they have mobility issues and always be able to connect with them is key to the immediacy of monitoring – feeling that your parent(s) are in the next room and simple check upon them with an intercom solution. Today Alexa Smart Assistants for example offer a drop-in capability where a carer can immediately drop into an AIP home with Alexa's drop-in enabled and the incoming voice or video call is automatically answered by the AIP Alexa device. This is an enormous advantage in the process of communication with elderly AIP persons with more and more of their time spent in one or 2 sitting locations during each day. Removes the issues with regular phones and smartphones

a. Always powered in Smart Speaker – so no battery rundown of mobile phone
b. Permanently located in the room and always available – DECT and Cordless phones getting lost
c. Does not require the AIP person to get up to find or answer the phone
d. Offers the ability to also do simple remote doctor visitations using quality video conferencing camera and audio. No issues with poor microphones or covered microphone muffled voice
e. Can use audio-only smart assistants in modesty rooms like bedroom and toilet. Can be a simple emergency solution for toilets to provide immediate audio linkage when required or allow fallen AIP person to call for help as augment to a pendant solution.

iii. **Use of Cameras in the AIP person's home.** The use of Cameras in the home to allow remote visual monitoring of the AIP home is a key part of the ability for someone who is usually on their own and does not have a daily person call and spends days on their own. Cameras can be seen as too invasive for many people to have in their home watching their every move but when confronted with the choice of (i) paying for home help (ii) burdening your kids and carers to call often and spend more time checking up on you (iii) not wanting to use other sensors in the home – the camera can be the best option for the AIP person to remain at home for as long as possible.

a. The key to the camera solution is to use them in the context of the AIP lifecycle and in particular when people have limited movement and ambulatory problems. When AIP persons are constrained to living in their house 24x7 and do not drive or only leave the house when family members take them out they usually get constrained to spending most of their time in 3 rooms in the house. With some mobility, they spend their times typically in 3 rooms – in kitchen for meals and variation of time spent in the room, in living room typically in front of

the TV and for change of location to kitchen, bedroom. The kitchen and Living room with camera additions give huge telemetry and contact with AIP to allow the longest periods of no visits to the AIP person or minimize the simple checkup time spent. When the AIP person's mobility is compromised they become essential to allow someone to remain in their home. They can even afford someone to spend all their time in a bed with the comfort of immediate access to their wellbeing and contact by remote carers and nursing staff.

b. The key to the camera is to also offer
    i. Motion and the new person in House triggers – as Carers and Kids cannot spend all day looking at Mom or Dad in their home
    ii. Fall detection – improvements in AI is now making this possible
    iii. Facial detection – improvements in the technology now make it capable to recognize regular visitors and carers vs new entrants to the home
    iv. Health checking by Camera – High-resolution IR capable cameras allow the ability to detect pulse rate, potential high and low blood pressure, changes in walking gait and other medical insights
c. Also offer fire and other detections (my not be as good as dedicated sensors for smoke or fire)
d. Offer with inbuilt speakers and mic – an alternative to connect if the primary phone or smart assistant connection is not working. Many cameras now have mic and speakers built in to be able to communicate briefly into the room.

Monitoring forms the most important phase of any Aging in place solution. One key question is will 65+-year-olds or their carers see and understand the value of having or providing an AIP monitoring solution. An effort will need to be put into marketing the solution values and the importance of early adoption and not the usual 'wait for something to happen' before doing something about it. The other element of monitoring is to provide a simple converged solution that is packaged like a typical MSO service where it's simple and integrated into the existing offering. The competition for an MSO monitoring solution is the Do it yourself process – so the integrated offering in the typical broadband, video, and mobile solutions of MSO will be the key driver to adoption.

The Figure 19 below shows the simple effect of the five simple MSO supplied or leveraged devices and sensory information to provide the single most important, simplest, and most effective service of AIP – the decision for carer or kids to visit their AIP parent. While visiting Mom or Dad can be a vocation for many carers and as we showed in earlier sections that 65.7% of kids are close to their parents and about 10% are very far so need remote monitoring. But as we have also shown even when carers and kids are close to parents it is a huge stress on their own lives and their time. *This monitoring solution offers as much potential to those kids as the far away remote kids – to provide as much care time as they can without having to visit because of worry of falls or other 'absent' information from their parent's home.* Philosophically it is a balance between their life and their parent's life and the heavy burden of guilt vs a nursing vocation drive. What this technology solution offering does is to provide the balance that seems to work with

- 100% reliable remote communication to Mom or Dad – avoid that huge frustration of not being able to contact home and worry
- Simple video triggers throughout the day – allowing an easy email or app scan to see AIP person is in good form and up and about
- Periodicity of function changes – AIP – especially when confined to house or room for much of the time gets to be very deterministic in events from the home (TV habits, motion habits, sensor value consistency) and these simple snippet updates give a fast 10-second 'everything's ok' view to the carer

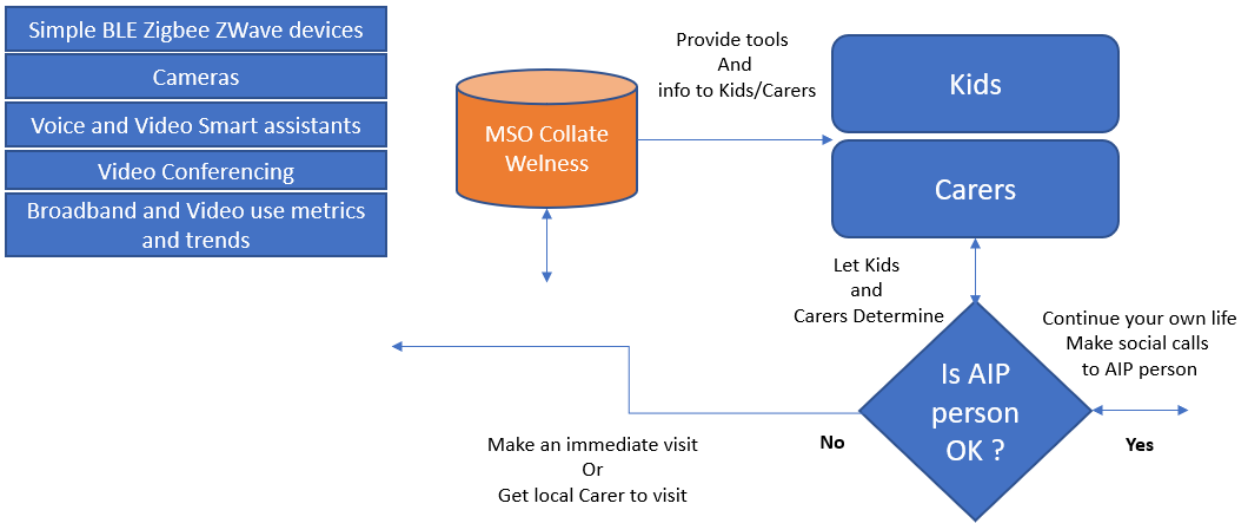


Figure 19 The simple monitoring flow diagram for AIP

The second phase in the AIP timeline solution is the 'Small Nudges and Checks' stage where the AIP solution gets more proactive in its engagement with the home. The areas that a proactive attempt at helping the AIP process in this stage are

- Reminders and Notifications: Medicine and medication reminders, doctors' appointments, scheduled visits to the home, bill pay reminders etc.
- Nudges and Checks: Take readings from any supplied IoMT devices like blood pressure or thermometers. Often the condition of not doing doctor visits is that the AIP person has to take their own readings continually. Automated locking of doors by adding smart locks to the doors. Leverage of Camera-based smart DoorBells, Automated turning on and off lights, Heating and Cooling use/on/off nudges and reminders, Food ordering nudges based on access to food order information, Pushed information from their carers and children – display on TV

Solutions already exist for these types of notifications and reminders but are usually SmartPhone driven and in recent times there have been extensions to smart assistants to also set up important reminders. The issue is a typical one that is also found in IoT generally in that it is

- Not fully understood by the population and demographic of 65+ AIP person and often not even by their Kids or Carers that these tools exist
- Still relatively complex for the majority of people
- Disaggregated and not consolidated in a simple Consumer Experience

For notifications and reminders, the Cable Operator has a better solution potential than the SmartPhone applications and that is the leverage of the TV as the main portal interface for all AIP communications. The ability to be able to access this large-screen format to affect these Aging in Place applications removes much of the inertia of the 3 issues above.

- Cable Operator provided a portal solution that can mix in AIP notifications, Video Conferencing in the same CX solution for the lean-back video experience
    - Can leverage the directions of the 2 most popular middleware solutions on STB/SMD to add services and applications
        - AndroidTV and App Store and other AndroidTV services

        - RDK V and the evolving improvements in the Downloadable Application Container solutions for both STB/SMD and Broadband devices
- Made simpler to work in lean-back mode utilizing simplest input devices
    - Aging in place adapted remote controls for ease of use. In some cases, it can be a large button remote for hard of sight elderlies
    - Use of Far-Field voice to provide input to the services and replies
    - Larger Font displays through the accessibility feature available in RDK and AndroidTV for sight-impaired AIP persons
    - Higher Audio playback for hard of hearing AIP Persons
- Even the control of the AIP persons STB/SMD by the remote Carer or family member to get the right channel or program is a well-traveled issue that many have seen when they are caring remotely for their parent(s)

Perhaps the most important nudge of all is the reminder for taking medication which in itself the feature dwarfs all others as the largest payback for the AIP process. Many AIP persons forget their medication or take it incorrectly. One simple scheme is to couple the notification of medication schedule with the TV experience and uses it to prompt for medication or taking readings from supplied IoMT devices. The TV screen and its engagement with AIP persons is a key opportunity to be able to provide all AIP services on the 65" palette that is the TV.

The last simple role the Cable Operator can play in the Aging in Place solution is the ability to help in the entrance and tracking of people into the AIP home. This is one of the key issues of the AIP process especially when there is a lack of mobility and hearing and the process of answering the door is both a difficult process and also opens security issues. Even when using solutions like food delivery when the AIP person is no longer driving on leaving the home un-aided the ability to answer the door can be the main inertia to the person staying on their own. So, a simple addition of a smart front door lock and camera solution tied to the Cable Operator solution and allowing

- Visibility of who is at the door – not only to AIP person but also to their carer or kids
    - On the TV screen and the smartphone app for both the AIP person and Carer/Kids
- Ability to open the door from the TV remote, voice or smartphone application – both for the AIP person themselves and the remote Carer/Kids
- Logging of open and close door events including thorough checking of the locking process of the door after people have left. Potential separate camera verification.

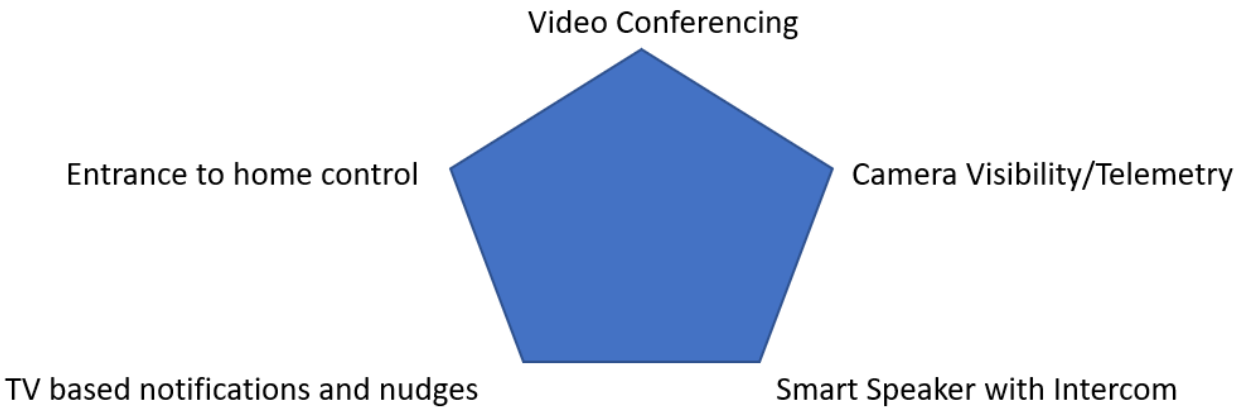


Figure 20 The 5 key tenets of simple AIP solution set for Cable Operators

With these 5 simple features, as shown in Figure 20, integrated into the Cable Operators current offerings and devices, there is a high probability of covering the key features that are required to provide the tools to the AIP person(s) to be able to control their own lives, reduce the burden on their Carer and Family circle and provide the realtime transparency to the home so that any event that happens that threatens their health is responded to immediately – either through direct voice and video access to the home or the dispatch of someone close to the home. This solution works really well for local carers and family members to keep their time optimized for f2f visits and removes much of the guilt of family members who are not close to their AIP parents by being able to cost-effectively direct local resources to help only when required or in a normal deterministic schedule.

The cost of these solution elements is also very low from both a capital investment perspective for both the Cable Operator and the Aging in Place home.

For the Cable Operator, the cost elements overlap a lot with the capital investment for the broadband and video and phone experience and the main constituents are

- Broadband Gateway with Wi-Fi – the **amortized cost for Broadband Service sale**
- Smart Media Device – **amortized cost with Video entertainment experience**
- Smart Phone Device – **amortized cost with Mobile service if offered by Cable Operator**
    - All AIP App elements can be downloaded on a third-party device
    - AIP person and their Kids/Carers also download and use Apps as part of service
- Operator supplied
    - Camera(s)– Prices can range from $25 to $900 depending on solution quality
        - Camera additions to Smart Media Device for lean back Video conferencing
        - Camera additions to other non-SMD locations
    - Additional in-room audio smart assistants – Prices can range from $55 to $180 depending on the configuration
    - Smart Door Bell including camera – prices can range from $120 to $300 depending on configurations
    - Smart Lock for Door – prices can range from $150 to $300
    - Optional LTE/5G backup devices for Broadband services
- Cloud storage and transaction costs for device telemetry and cloud to cloud partner and Care Portal engagements
- Additional Technician costs for installation of AIP additional devices in particular Front Door solutions of Doorbell and Camera
    - There is the scope that these can be done as Self Install Kits given the reasonable simplicity of Doorbell and Lock installs
    - Internal Camera installs can all be self-install for AIP or Family members to do

4. The Cable Operators solution play for Aging in Place

This section along with Appendix A, will define the recommended AIP Home architecture and the role the Cable Operator can play to provide a valuable service to this market where the price of staying at home as long as possible can sometimes be not even defined in monetary terms. Finding the balance of

(i) Existing CAPEX spend and OPEX spend on install and support for Broadband Video and Mobile services

(ii) Adding in additional elements to the existing Broadband Video and Mobile devices to support the AIP market and to abstract this for maximizing the almost 9% of your network

and 55M people in the US that can avail of the service. Sharing this CAPEX investment is key to the business proposition

(iii) Looking at the extension of Aging in Place investment and it's additional overlap to the Telemedicine business for **EVERY** customer on your network. Aging in Place solution and Telemedicine services have a lot of overlap with investment and partnership opportunities

(iv) What the Operator provides vs Care Companies, Insurance Companies, Health Providers and Government support agencies for improving aging life and reducing the cost of out of home care

(v) Providing client devices that add to the support of Aging in place but minimize the medical nature of the offered AIP service. Leveraging a Smart Home and Security solution to also support key non-medical Aging in place services

(vi) Leveraging existing Cloud services to create the Cloud to Cloud telemetry connections to specialist Aging in Place partner solutions.

(vii) Leveraging the change in services architecture paradigm of moving away from locked Operator services on Broadband and Video devices to one where containerized service can be added to the connectivity network to effect new services through the devices and endpoints in the home.

Figure 21 illustrates the key eleven elements of the Cable Operators solution for *AIP Home*. These solutions focus on the simple non-medical elements that make Aging in Place work with the virtual access to the home by carers and family. It also allows the Cable Operator to partner with AIP partner companies offering resources and services to the AIP process ranging from - home help services, food and meal preparation services, medical services, insurance services, specialist care services, etc.

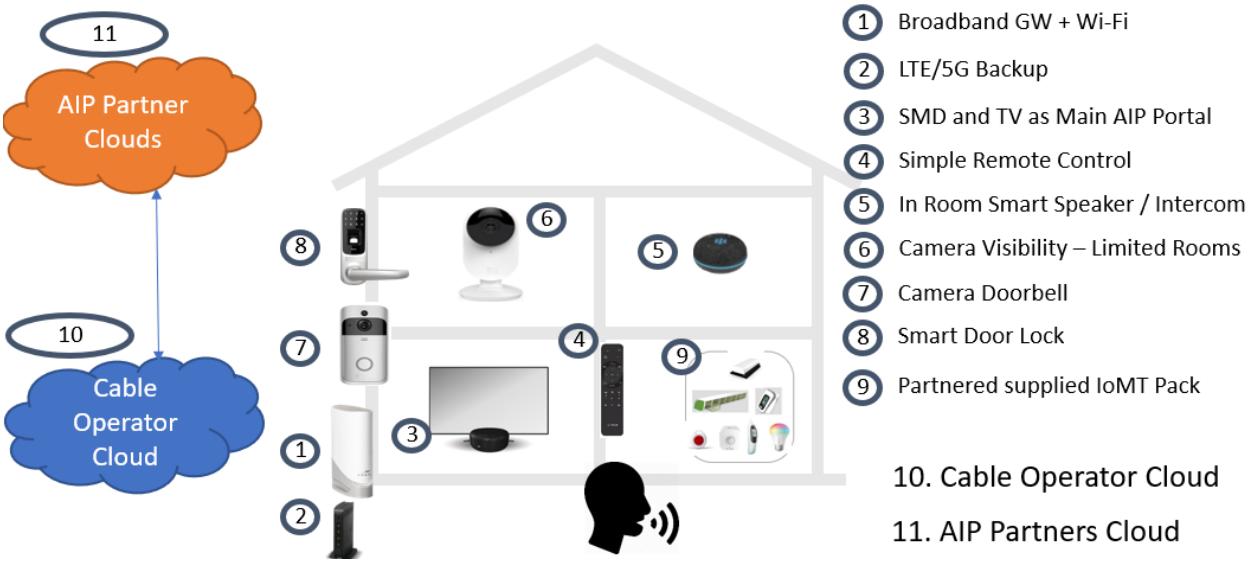


Figure 21 Eleven key service offerings from a Cable Operator to support AIP Home

A detailed discussion on these eleven services, their needs, the opportunity, the cost (CapEx and OpEx) implications, and the application extensions (such as telemetry) are provided in the Appendix.

5. Business case with estimates of tiered service prices

Before putting together the business case for the AIP solution proposition for a Cable Operator, let us look at some assumptions –

- The average life expectancy in the US is 78.6[13] years in 2020 and it is trending up: The likelihood of people dying or leaving their home is part and parcel of the AIP business case process. When you are selling solutions and investing CAPEX in the 65+ customer base you have a much higher probability of any invested capital or install costs for recurring revenue that may not reach their full potential. The life expectancy of 78.6[13] for the US population determines your strategy. Figure 22 the probability of dying at different ages. This gives an idea of how the aging population and their supporting team think about different investments to the *AIP Home*. So, for risk mitigation, it probably drives a balance of getting some upfront capital investment costs for any solutions offered and a recurring revenue opportunity.

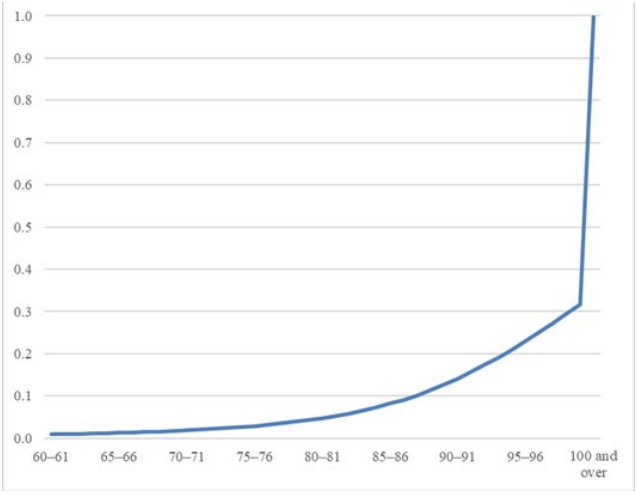


Figure 22 Probability of dying between X and X+1 years

- The financial stability for the aging population from a Lifetime Income[14] point of view is essential for the future *AIP Home*: Increasing life expectancy and lack of proper financial planning will severely impact the lifestyle of the aging population. Supporting such financial services and also bundling the technical solutions to meet with the *AIP Home* is essential for the wide-scale adoption of the services that we discussed in this paper.
- The fragility of the aging population forces innovative and expeditious services: Injury like a broken hip (300,000 seniors break a hip in the US each year of which 70% of them are women) forces the aging population, especially *AIP Homes,* to adapt to their conditions. Studies have shown[15] that the mortality rate of a broken hip over 65 years of age doubles over 12 years after the broken hip. In usual care, the reported 1-year mortality after sustaining a hip fracture has been estimated to be 14% to 58%. The relative risk of mortality in the elderly patient population increases by 4% per year. The first year after a hip fracture appears to be the most critical time.

The above elements reinforce that AIP investment should be either (i) some upfront cost for CAPEX and monthly lease fee for equipment and service (ii) buy out option of the equipment with a monthly fee for service. The affordability of the technology assists in remaining at home is somewhere between

- Pay anything to remain at home and reduce the burden on kids and remain independent
- The average income of the 65+ age group who are not working is $1,700 per month
- The average cost of Home Health Care of $4,000 per month deducting what Medicaid offers to support for Home Care[16] such as, home and environmental accessibility modifications (alterations such as wheelchair ramps, walk-in bathtubs, stair-lifts, and environmental aids for lighting), medical equipment, and supplies, Personal Emergency Response Services (PERS) are electronic monitoring or call and respond services that enable persons to live alone or to spend portions of their day without direct supervision. There are four different categories of programs within Medicaid that offer funding that can be used to pay for electronic safety monitoring for the

[13] NVSS, *National Vital Statistics Reports*, June 2019, available here
[14] American Academy if Actuaries, Risky business: Living longer withour income for life, June 2013, available here
[15] Geriatric Orthopedic Suegery and Rehabilitation, *The 1-Year Mortality of Patients Treated in a Hip Fracture Program for Elders*, Sept 2010, available here
[16] Paying for senior care, *Medicaid's home care benefits: Eligibility, waivers and application information*, August 2020, available here

elderly (therefore for PERS / medical alert services) (Medicaid Waivers, Consumer Directed Services, Medicaid State Plan – Personal Care Attendant, Money Follows the Person. There are also non-Medicaid sources of financial assistance for PERS devices[17]. Some of them are provided in the table below.

- There is also a high probability that Family Members will also help out with the costs for technology-based AIP solution. They have the greatest to gain by minimizing their face to face visits to their parents to when they want to go versus having to constantly check if their AIP parent is ok. They may also be able to continue to claim the carers allowance themselves while using the technology packs to make their visit times much more efficient.

Service Type	Description	Cost
Basic Service	Wearable pendant to a call center for emergency response	$25 - $50 / month
Mid Range	Pendant / watch with automated fall detection, call center, emergency response, family notification	$30 - $60 / month
High End	Wearable device, multiple in-home sensors, two-way communication, online reporting, emergency response, multi-party notification and add-ons	$500 - $1000 startup and $50 - $100 / month

The current costs for these PERS services are defined above. The AIP solution being proposed in this paper does cover the PERS safety monitoring requirement and extends beyond this with other functions that really cover the stay at home independence inertia items like Door Ingress and Egress. The ability for both the camera and the drop in audio and video services as well as additional features in the remote control unit – all improve the ability to do PERS.

A note on AIP technology adoption

Age related issues *don't really respect the socio-economic demographic*. While more money in retirement can help you pay to stay healthier – a serious fall levels everyone. Other degenerative diseases also drive same decline no matter how much money you have.

For technology based assist solutions there is a belief that the *adoption* of this type of service will start in families that have that *bit more money and are already tech-savvy* having seen the benefit of consumer IoT devices and smart assistants. In fact many of these families may try and help their AIP parent(s) with Do it Yourself Technology solutions. We would like to think however, that these proposed AIP technology solutions can find their way to the poorest demographics as they may have the largest impact in keeping these seniors in the own home and out of the stressful work of assisted living, day care and other hugely expensive burdens.

Its also hoped that *the Medicare and Medicaid services can also look to these technology solutions* as driving large savings in their premium payouts and extend PERS and other coverage items to include the suggested device sets indicated in this paper. Why is a DOCSIS GW , WiFi AP , Extender or IoT hub not a potential insurance subsidized device given roles in preventing injury and providing reliable immediate triggers when threshold of sensor readings are breached and doors are opened. More work needs to be done to move more of the technology assists in the home for AIP into subsidies from insurance companies.

[17] Paying for senior care, *Medical Alerts & Personal Emergency Response Services Costs*, May 2020, available here

We believe, as highlighted in the insert "*A note on AIP technology adoption*," this market opportunity will take off for the Cable operators. Let us look at the business case for the Cable Operator in Aging in Place. For the purposes of this paper, to make it simple, let's assume

- Margins on the proposed services below are even better than Broadband margins
- Because of the lower survivability rate in this age group (65 and above), we have to reduce risk on Capex and Opex investment
    - So, most models will be upfront installation cost with recurring lease cost on device
    - The AIP services as a Software Service will be licensed as yearly maintenance costs for the additional software updates and improvements
    - Some higher initial onboarding costs for third party OTT AIP service providers – the assumption being that a limited number of partners per region or state will be used
- The services below do not include the cost of basic triple-play services and the device lease costs.

So the following analysis outlines 5 simple illustrative AIP Packs. The potential revenue opportunities are highlighted in the table below.

AIP Service Offering Costs	Install cost	Upfront cost	Leasing cost/mo.	Purchase cost
(1) Family communications pack				
SMD + Video conference	$50	$200	$10	$500
Additional SMD + VC	$50	$200	$10	$500
(2) Wholw home family communication adder				
In room smart audio assistant + IoT			$8	$99
Two pack - in room smart audio assistant + IoT			$14	$180
(3) Entrance and egress security kit				
Smart doorbell	$60			$150
Smart doorlock	$120			$250
Smart doorbell + doorlock pack	$150			$325
(4) Camera				
1080P only single camera	$50		$7	$120
Two pack 1080P only cameras	$75		$12	$225
4K single camera	$50		$12	$200
Two pack 4K cameras	$75		$20	$390
(5) AIP for IoT pack				
Motion sensors	$100	$100	$4	
Smoke and fire detection				
Kitchen sensors				
Toilet flush sensor				
(6) Skills support				
(1) + linkage to TV and TV notification			$15	
(2) + linkage to TV, remote, voice system			$20	
(5) solution software			$20	
AIP care portal connect service (Care portal to add services to devices installed)		$250	$50	

(1) Family Communications Pack: This service focuses on a simple large-screen video conferencing integrated into the TV experience. Features include - Smart Media Device and Camera bundle, Smart Phone App for Family and Carer Givers, Features like TV pause when a call, Family members can leave notifications on the TV screen, etc. This package can be for one room or more than one with additional service and equipment lease. It offers options for complete buy out of the device vs lease cost.

(2) Whole-Home Family Communications Adder: This service adds Audio only Smart Assistant adders to additional 'modesty' rooms.

(3) Entrance and Egress security kit: This service includes, Smart Doorbell and Smart Lock combination for TV controlled secure visitor ingress and egress to the home. Note that the installation costs are higher in particular for the Door lock.

(4) Cameras: Add 1080p and 4k camera options added to the SMD camera solutions. These can be placed in other rooms or on outside locations for TV-based security assessment

(5) AIP IoT pack (for non-medical devices): This service focuses on non-medical related IoT packs on giving the Family and Carer simple daily life functions transparency. These devices include - room motion sensors, sleep sensors, toilet flush, kitchen sensors (fridge, microwave, and hob/oven usage), in room location, smoke heat gas detection, etc.

All of these are tied to the Family and Carer Giver app and are displayed on a TV. These skill packs are charged additionally to the device costs/leasing costs and will have constant innovation on them as well as requiring cloud resources that will cost on an annual basis.

Sample pack contents	Upfront cost	Purchase cost	Per Month	Take rate	PM Revenue	PY Revenue
(1)	$200		$25	10%	$3	$30
(1) + (3)	$200	$675	$45	20%	$9	$108
(1) + (3) + Two pack 1080P (4) + (5)	$300	$825	$81	25%	$20	$243
(1) + (2) + (3) + Two pack 4K (4) + (5)	$300	$925	$103	30%	$31	$371
Above + AIP Care portal	$250		$133	15%	$20	$239
					$83	**$991**

How will this then roll out to the AIP population with different requirements depends on privacy, different budget levels, etc. The above simple table outlines 5 configurations of the above packs from a simple one SMD VC communications pack to a premium most of the services selected in more than one room pack. These range in price per month from $25 to $133 per month. A Take rate estimate of the 5 packs is shown in the above table with Pack 4 is the most popular at a 30% take rate. Using this trivial simple take rate – the average cost per month is about $83 per AIP home. Note there is also upfront payments additional to this per month price as well in our proposed model.

This is in line with research data and PERS costs shown above (this solution goes beyond basic PERS features) that show AIP persons or their family willing to pay at $50-$99 per month to remain as independent as possible at home.

Target market (yearly revenue projections)	Market size	Take rate	Revenue (Billions)
AIP Homes (Total market for 65+)	56,000,000	3%	$1.67
		30%	$16.65
		50%	$27.75
Elderly on their own need help	3,750,000	3%	$.11
		30%	$1.12
		50%	$1.86
> 65 households in 2M subs	170,000	3%	$.01
		30%	$.05
		50%	$.08
Elderly on their own needing help in 2M subs	45,000	3%	$.00
		30%	$.01
		50%	$.02

As a final step to give a quick feel for the overall opportunity for revenue let's look at a very simple model of 3%, 30% and 50% take rates of the 2021 AIP population across

- The entire 56M AIP Homes base
- The smaller subset of Elderly on their own already needing ambulatory and other help – 3.75M
- And a simple hypothetical 2M subscriber MSO for their revenue return

As you can see below it could be a $28Bn per year market if 50% of homes over 65 had such a Cable Operator supplied solution. Even with those needing help now at 50% penetration, it's a $1.9Bn per year revenue opportunity. For a 2M subscriber Operator with 50% of their 65yr+ homes taking a solution – it's an $84M per year opportunity. And if only 50% of the AIP people already requiring help take it – it is a $23M per year opportunity.

Of course, there are other elements that can be further considered, such as -

- Additional Broadband and Video services for new subs or upgrades to existing ones
- Stickiness – AIP person is likely to never leave Operator as Broadband and Video Provider

- Stickiness – their family and carers may also switch to the Broadband and Video services of their AIP parents if they see the additional value. And there could be family packs offered at some overall discount as a new tier of service
  Additionally, AIP services that go beyond that are only technological specific

6. Conclusions

As Cable Operators enter the next decade between 2020 and 2030 there are a number of key trends correlating to allow them to add new high-value revenue opportunities. As Operators move to the 'quad-play' of Voice Video Data and Mobile – there is another level of Service that is emerging in the Aging in Place and Telemedicine space. This area offers high value per month returns to the Cable Operator and potentially $82 per month revenue from 9%+ of its subscriber base. With the advancement in IoT devices, Far-Field Voice and Smart Assistants, and in particular the evolution of the STB to the Smart Media Device a Cable Operator has a device arsenal that can be re-purposed and in some cases double-dipped to Aging in Place revenue opportunity. By choosing a simple path based on connectivity, SMD, home communication, home ingress, and egress, and home telemetry solution and extending to partner with specialist AIP companies the Cable Operator can provide a longer time at home for many of their Elderly and aging customers. Not only is it a profitable solution direction but a hugely worthwhile solution space that can improve the lives of up to 55M people in the US but also bed in a new digital home solution that will also grow to improve Telemedicine and other home services.

Appendix A: Some solutions operators can offer for AIP Homes

Service offering	Opportunity information	Additional AIP needs
Broadband GW and Wi-Fi: Fundamental components that can be primary internet services to 20% of the *AIP Homes* that do not have an internet connection.	20% of the AIP Homes CapEx is absorbed in operator spend. No additional OpEx.	Option to use the connectivity telemetry and data from the home and apply it to AIP trend analysis. Simple ML-based trending of internet usage (no use – alert carers), health and status of connected devices, changes in numbers of connected devices, new devices present in the home.
LTE/5G backup: The solution to resolve an outage on the HFC network is to supply a backup LTE/5G solution that can switch over reasonably fast and support the WAN internet connectivity for all the in-home AIP services and communication. This can be charged on a per-use basis to minimize the cost of LTE and also to make it easier for those AIP families to purchase the service when worried about the cable network dropping.	For those families looking for beyond 5x9's reliability of connectivity to an AIP place home. No additional CapEx Requires OpEx through additional training and installation from a technician (could be self-install) and support costs and training.	Needs additional support for the health and provisioning of the LTE device as well as a solution to be able to reliably swap access support from Cable to LTE and back again. No real specific AIP elements are required.
SMD and TV as the main AIP portal: The STB is on a new evolution trajectory to move from being just a traditional decoder to being an in-room device that can open up the 65" TV as the portal for many services including AIP. The device itself and the location of TV's in the AIP home – correlates with the two main rooms that the AIP person spends most of their time outside of the bedroom. Typically these rooms are (i) kitchen and (ii) living room – which as mobility decreases in AIP lifetime the AIP person spends more time sitting and in front of the TV. This makes the SMD the idea device to become the AIP command	As the Cable Operator moves from humble STB to the Smart Media Device solution and brings in new Smart Media devices – they can enable an AIP service to the device easily with the addition only of a Video Conferencing camera as an additional service over their regular	The opportunity to be able to leverage the SMD Portal to both the TV pixels and speaker audio to be able to connect AIP resources to the AIP person.

Service offering	Opportunity information	Additional AIP needs
console for both the AIP person and their carers to connect and communicate to minimize the burden of face to face visits and care. With the use of Videoconferencing, it also makes it much easier to have immediate and frustration-free discussions with parents to improve their psychological well-being.	next-generation TV experience evolution. Potentially Cable Operator can absorb Smart Media devices in its evolution to IP Video over Wi-Fi CapEx and adds more Far Fied voice and visual smart assistant support. Requires additional training and support for the SMD and AIP services.	
Simple remote control: As we age our ability to use and work with devices that can be lost or misplaced, are hard to see, have small buttons, have complex button presses, etc. These can be a source of massive frustration as well as potentially stop the ability to accept incoming calls or simply change the channel to watch a favorite program. Changing the design of the remote control to be *AIP Home* friendly such as be less easy to lose or slip down the side of the chair, have bigger and fewer buttons, support push to talk voice to enable services and smart functions, have a remote from home initiated 'find me' beep or noise function to locate it. The remote can also be repurposed to be a pendant remote control that can also provide emergency alert services. Idea's for this service include: Adding accelerometer and **gyrometer** support to the remote to detect falls and rapid movements – with an automated call out to Carer or Family member, Red button press to engage carers or specialized call out services, etc.	Opportunity to create a differentiated – fit for function – AIP friendly remote control device. This would be a separate SKU of remote for AIP purposes. Requires additional training and support costs.	Needs additional support for the services added to the remote – particularly if its IP addressable and supports the 'find me' and emergency alert services.
In-room speaker/intercom: To complete the coverage of the *AIP Home* transparency and visibility for Carers it is important to add additional communication devices to the 'modesty' rooms in the home like a bedroom and possibly toilet. This completes the formula of being able to constantly contact the person and also afford them the potential to constantly contact their carers or family as they move around rooms. The addition of an audio-only smart assistant will complete the	The opportunity here is to introduce general whole-home voice and audio for the general population but to also drive this for an AIP specific application. The operator supplied Smart Assistant solutions	Needs additional support for the IoT and Voice/Audio data models to support management and provisioning of the device. AIP applications can be applied to the device

Service offering	Opportunity information	Additional AIP needs
transparency coverage of the home and make the *AIP Home* very much a virtual extension of the carers and families home – with a minimum burden and maximum return. The Operator can also affect another level of security and privacy over these audio listening devices and also include easier point to point access to designated only listeners or call endpoints – typically just the AIP carers and family members. The device can also offer additional IoT radios to also engage with non-BLE solutions added to the home for smart IoT or even non-BLE IoMT solutions.	have additional advantages for home use. Absorbed in normal Cable Operator Capex spend : Potentially. The addition of Far-Field Smart Speaker based solutions as an augment to the SMD Visual Smart assistant is an architecture that has merit for creating a new whole-home platform for new services including Aging in Place services. Requires additional training and installation from technicians (could be self-install) and support costs and training.	– but typically will be cloud hosted and leverage skills frameworks that have already been integrated for regular consumer services.
Camera solutions for room visibility in defined areas: Cameras in the home cause lots of discussion about invasion of personal privacy. However when confronted with having to -leave the home for Assisted living or Nursing home, add more burden to family and carers with more visits to *AIP home,* increased cost in home health care, worry about being on one's own so outdoor camera solutions can give peace of mind, these concerns will lessen. The addition of Cameras to the *AIP home* – is a much more palatable and acceptable solution to the AIP person when it adds this value. Cameras in the home for AIP should be allocated in the following 'modesty' fashion - they should only be added to rooms like Kitchen and Living Room , they can be combined in those rooms as both constantly viewing devices and video conference solutions – especially when combined with SMD and TV, they have additional role to provide a view of front door to the TV and Smart Phone for automated visitor access to the home, their telemetry can be also used for other AI based and AIP and Telemedicine services using video to extract meaningful home insights	New class of device and service that has multiple roles across the general customer services but a specific relevance to Aging in Place services. New chargeable device as part of AIP or Security initiatives. Additionally, options for charging for recording or AI services on the data as part of menu of services on video telemetry. Requires additional training and install from technician (could be self install) and support costs and training.	Video and Audio recording services as well as events like motion , person and other finer grained AI derived services. AIP applications can be built on the Video services and solutions that can analyze heart rates, changes in walking gait, falling as well as fire , smoke or other solutions can be overlaid on the data collected.

Service offering	Opportunity information	Additional AIP needs
For the Carer and Family cameras - provide more value to them than the AIP person and so are their main vehicle to establish wellbeing of AIP person, provide a fast way to track the activities of the day like eating and drinking and visual verification of taking medicine, provide a way to approve ingress to the home for visitors remotely with confidence – a scheduled visit or repair service etc., provide emailed or Instant Message event triggers with captured frame or video snippet for activity in the room – making it easy to verify the key events of the day of (Up and going, in the relevant rooms, moving, time based changes of rooms, visitors etc.) The Operator can supply these cameras solution as part of Video Conferencing service on SMD as well as extra cameras for Door and other rooms as part of their service. Camera solutions scale outside the AIP opportunity to other home peace of mind security services and in particular of infrequently occupied second home monitoring services. The device can also offer additional microphones and speakers to also support camera based intercom features. The Camera should also support IR and Nightvision modes to be able to support visibility through 24 hour period. Cameras will also trigger alerts at any fire's starting in the home as motion events.		
Camera doorbell: One of the limiting factors of Aging in place that is solvable with technology is automated entrance to the home for visitors and also answering the door to strangers when desired. This is a particularly important feature when mobility has reduced of a single Aging in Place person. Allowing delivery of food with trusted people as well as scheduled maintenance or health workers using a secure automated door solution is a key part of elongating the stay at home battle of aging in place. Adding a Camera doorbell provides this capability and can uniquely be tied to the STB and SMD by the Cable Operator to allow someone who spends their time in a chair or bed to also control entrance to the home.	Opportunity : New class of device and service that has multiple roles across the general customer services but a specific relevance to Aging in Place services. Absorbed in normal Cable Operator Capex spend : New chargeable device as part of AIP or Security initiatives. Additionally, options for charging for recording or AI services on the data as part of menu of services on video telemetry.	Video and Audio recording services as well as increasing ability to do facial recognition on the door bell camera. Logs of entrance and egress to the home as well as being able to deal with unwelcome people at the front door. Gives also an additional level of security as people don't loiter when they know they are on cameras.

Service offering	Opportunity information	Additional AIP needs
	Additional Opex costs : Yes – requires additional training and install from technician (could be self-install) and support costs and training.	
Smart door lock: Works in conjunction with the Smart Doorbell to provide a good secure automated solution to grant secure access to approved visitors. With key elements of aging in place being - food delivery, health worker visits, ambulance visits to take you to scheduled doctor visits, amazon or online services delivery etc. The ability to automatically open the door by the AIP person or even remotely by the Carer and Family can be a huge help in remaining independent in AIP timeline. There are additional devices that can be fitted to the door to make sure it closes when opened as well as the door lock telemetry for close to ensure highest security levels on the door closure process.	New class of device and service that has multiple roles across the general customer services but a specific relevance to Aging in Place services. New chargeable device as part of AIP or Security initiatives.. Requires additional training and install from technician (could be self-install) and support costs and training.	For security purposes the application of software solutions to ensure the door is properly closed and the door/open close correlated to the doorbell telemetry ensures complete visibility to the door access solutions.
Partner supplied IoMT pack: There is a place for the Cable Operator in the medical devices that can be required in the Aging in Place journeys. Typically, they will be supplied by specialized Health Care Companies, Insurance companies, Specialist Aging in Place solution providers and in many cases come pre-provisioned for immediate send of information to a care portal database. The Cable Operator can add value to this service by - providing the IoT hub elements to connect the IoMT devices (Typically BLE but also offering Wi-Fi and ZigBee and ZWave onboarding, doing BLE to IP conversion from the device, supporting reliable first time pairing of the devices to the IoT hub and connection to the cloud etc.), displaying the status and onboarding and results of the devices integrated into the both (The SMD visual display on the TV, any Operator supplied Smart App, integrating the IoMT devices into the Cable Operators TV Consumer experience, Adding audio playback of the recorded values for sight challenged AIP	Partnership opportunity with specialist monitoring and Aging in Place care companies. Cable Operator provides the Hub function to the IoMT device pack issued by the partner monitoring company. Cable Operator takes a fee for the onboarding service and integration into SMD visual path for notifications and other services. An OTT service that can be added to the Cable Operators service architecture for other services like their own IoT	The solution should probably be offered as Virtual Network Function added to the Cable Operators network and together with containerized application solutions added to the Broadband and Video Service delivery system – offer the Cable Operator the option of being able to partner with specialist Caring Services and Resources. It is not expected that the

Service offering	Opportunity information	Additional AIP needs
person(s)), adding additional security and redundancy via the addition of LTE/5G WAN backup. Opening up cloud to cloud interfaces between the Connectivity path and the Medical Cloud to provide secure reliable integration with the home User experience. This is typically done by - Cloud to Cloud interface definitions, containerized applications that can be added to the SMD and IoT hubs to gather IoMT information, providing logging solutions to ensure trace back of readings and frequency.	services and even Wi-Fi management. Additional effort required if Cable Operator provides more features in the connection of IoMT to the specialist Aging in Place providers cloud. No additional or at least very minimal as part of the next phase of addition of containerized services into the Cable Operators Broadband and Video and Smart Solutions.	Cable Operator does anything with any data from the IoMT devices except to provide tools to ensure they have onboarded and remain connected as well as other alerts for any outages or unscheduled disconnects.
Cable operator cloud: As mentioned in earlier sections – the expected solution for Cable Operators AIP business is to provide additional cloud support to the (1) Cameras and Smart Assistant based services – offering additional access to these devices directly to AIP person(s) and carers and family. There can be opportunities to also allow specialist AIP companies to access cameras with permissions from family and AIP persion(s). These services can be provided cloud to cloud (2) Doorbell and Smart Lock solutions as extensions of any Smart Home or Security solutions offered by the Cable Operator. The Cable Operator providing the automated entrance service to the AIP person is a cloud hosted application and needs additional services to ensure closure and alerts to AIP family and carers if closure contact is not made. The specific IoMT pack is not typically controlled by the Cable Operator and is typically a pass through service that the Operator will offer to the AIP either through partnered solutions or potentially to designated solution offerings recommended by the family or AIP themselves. The definition of the interfaces to these third party IoMT monitoring and care portal companies has no specific standard at the moment but there are several potential solution architectures for this that could provide some future telemetry and information sharing from Cable Operator domains to AIP resource domains. For now the simple mechanism is to send all the IoMT information through the Cable Network to the defined cloud endpoint after VNF and		

Service offering	Opportunity information	Additional AIP needs
Containerized applications for AIP Resources are installed in the Cable Operators Service Delivery Platform.		
AIP partner clouds and cable operator interfaces: This area demarcates the non-Medical and Medical elements of Aging in Place. In the paper we have outlined the value areas that the Cable Operator can add from its own cloud to home AIP services. However there is another important opportunity that can be also added to the Cable Operators services to the AIP home. The specialist Care Companies, Medical Resources and other Aging in Place resources can connect either - Directly through the operators network to the devices, Support some potential for Cloud to Cloud integration for Operator supplied value add services to the medical or other AIP OTT services This offers the potential to be able to – (1) Onboard with Operator supplied Hub devices (for its own AIP and general Home IoT and Smart Home services) rather than additional hub. New Software Delivery schemes unlock the possibility for a containerized AIP medical app to be added to support Aging in Place medical device packs and other internet connected services above the basic ones supplied by the operator. (2) Offer additional Operator pulled telemetry and even Machine Learning to the AIP resource cloud service (potentially driving some standardization of data sharing) and combine this information for a better overall service from the specialist AIP service provider This is a more complex proposition for the Cable Operator as there are many AIP specialist companies, and they differ regionally throughout the US. In most cases the AIP resource company is recommended by - Doctor/Hospital, Rehab center, Day Care center, Health Insurance Provider. Or researched by Family member or AIP for the Home Help or monitoring solutions. But the potential does exist to be able to onboard and integrate with these solutions typically via - software architectures to allow downloadable services in Operator supplied devices, cloud to Cloud integration		

Service offering	Opportunity information	Additional AIP needs
and definition of interfaces to share data and information. More research and 'analysis needs to be done in this area of interfacing with Aging in Place medical and other specialist services. Data exchange and the privacy of data will also need to be expanded and is outside the scope of this paper. While there is the HIPAA and PHI specifications to govern access to sensitive medical data generally all data from the AIP person and home will start to become more privacy focused – particularly when simple sensor information combined with medical devices can be merged in an overall view of AIP persons health levels. There has already been a new act created in California – the California Consumer Privacy Act – CCPA which is similar in many ways to the trend in Europe with the General Data Protection Regulation being put in place to define rules around consumer privacy in a digital world. Before going onto the next section we will also mention that there are many other additional sensors that could be added to ensure more safety and peace of mind visibility in the home. These include but are not limited to - motion sensors, smoke and fire detection, sleep sensors, toilet flush sensors, fridge open sensors, door open sensors etc. These can be added as required to the Cable Operator Aging in Place pack and the telemetry added into the flow for the Carers and Family members to interpret. These devices can provide safety and security features as well as general indications of healthy hygiene practices for the AIP person. Declines in the normal levels of feeding, toilet frequency and sleep can be used to pre-empt medical issues and get earlier family and doctor interventions. These statistics can also be combined with supplied medical devices telemetry to get a clear picture of overall health and aid prognosis by Doctors.		