THE WORLD IN 2040

The future of healthcare, mobility, travel and the home

SUPER-SMART LIVING: THE MID 21ST CENTURY HOME

Allianz Partners

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About the Author

Ray Hammond has been researching, writing and speaking about future trends and developments for almost 40 years.

He is the author of 14 books on the future and he has written, consulted and lectured for the world's great corporations, for governments and for many universities in Europe, the USA and in Asia. He is regular broadcaster on both national and international radio and TV channels.

In 2010, Michal Gorbachev presented him with a medal for his services to futurology which was issued by the Italian Chamber of Deputies on behalf of the United Nations. In the citation, President Gorbachev wrote:

> "We are delighted to honour Ray Hammond for his constant commitment to research and for his stunning speculations about the future, enlightened by scientific knowledge and an evident concern for humankind."

Author's Note

This report represents my own opinions about likely future developments. It does not represent the views of Allianz Partners. When I was asked to research and write this report, I was provided with guidance about the topic areas to research, but I was given a free hand to develop all editorial matter independently. Any errors and omissions are my own responsibility.

Super-Smart Living: The Mid 21st Century Home

In 2040, new houses will be 3D-printed on site, they will incorporate network connections and sensors in their walls and floors and they will be assembled by construction robots. When occupied, these connected homes will be staffed and run by teams of domestic robots.

These super-smart houses and apartments will cost at least 60 per cent less than today's equivalent homes and will be built and fitted out in just a couple of weeks. If local planning and zoning regulations are amended to make it possible, 3D additive manufacturing and robot construction techniques have the potential to end the housing shortage that affects so many nations.

Most new-build dwellings of 2040 will be energy neutral – many will be energy positive – and will provide occupants with a multitude of digital services. Each home will be a platform for software and robotics which provide security, comfort, climate management and a constant stream of smart services and entertainment to its occupants and visitors. The smart home of the mid-21st Century will be a hub in the Internet of Things (IoT).

It's important to stress that I am describing newly-built homes in this section, as there is a huge stock of 'legacy housing' which will not be retrofitted to be fully smart by 2040. This large stock of old housing exists in all developed nations and many emerging economies.

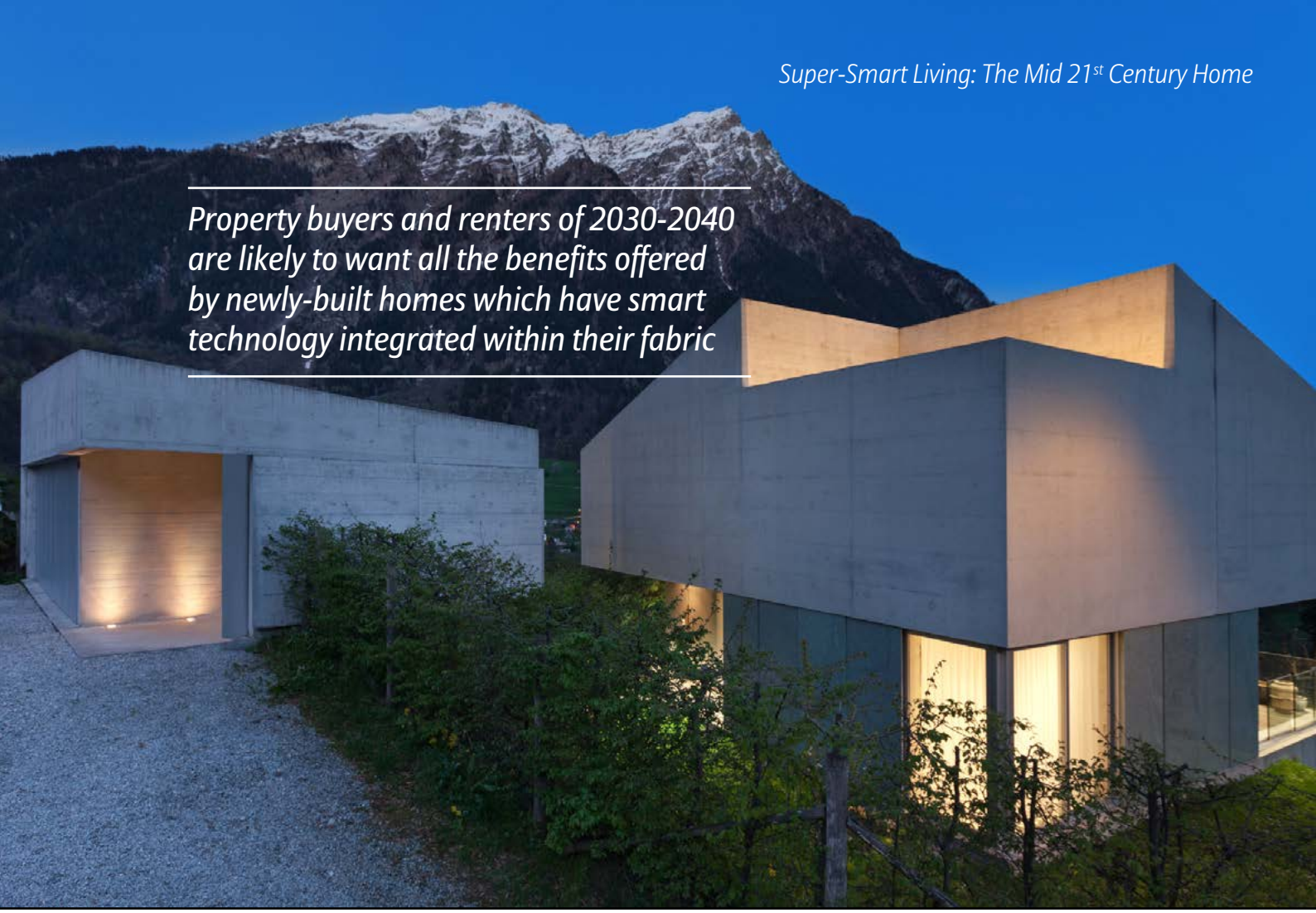
Many older homes will be upgraded to incorporate some smart technology – especially energy-generating and energy-saving technologies – but only brand-new homes which have been built around software and robotic technology (rather than having such facilities added as an afterthought) will be able to take full advantage of the powerful AI, robotic and sensor technology delivered by a fully-implemented "Internet of Things".

7G will be the world standard for wireless communications in 2040, which will be 100,000 times faster than 5G

In 2040, broadband internet access and cellular smartphone network technology will have merged into one form of super-fast wireless network provision. 7G will be the world standard for wireless communication technology in 2040 and this is likely to be at least 100,000 times faster than the 5G technology that is due to be rolled out in 2019.

These ultra-high-speed networks will allow multi-sensory, virtual reality environments to be created instantly and with a degree of realism that rivals the physical world. And 7G networks will also enable the rapid transfer of large design files, enabling the smart home of 2040 to become a 3D-printing centre with the ability to make clothing, toys, sports equipment, tools and many other items.

These super-fast networks will also provide the infrastructure to carry the vast loads of data generated by the smart home of 2040.



Property buyers and renters of 2030-2040 are likely to want all the benefits offered by newly-built homes which have smart technology integrated within their fabric

Smart Homes and the Property Market of 2040

Recently, car dealers have started to complain that younger car buyers are thinking of cars as 'smartphones on wheels' rather than conventional automobiles. These customers are becoming much more concerned with the digital technology supplied within new cars than with traditional car-buyer concerns of styling, performance, speed, economy and 'driving feel'.

These younger buyers who are making traditional car traders feel so uncomfortable are members of the 'millennial generation' (those born between the mid-1980s and the year 2000) and were brought up with the internet and digital technology.

Digital services, internet connection and convenience drive most aspects of their lives.

By 2040, this group will be well into middle-age and the generations that follow them will be increasingly digitally-immersed and will expect the world around them to be continuously connected.

For this reason, the property buyers and renters of 2030-2040 are likely to want all the benefits offered by newly-built homes which have smart technology integrated within their fabric.

This is likely to skew the property market strongly in the favour of new-build stock and this demand for truly smart housing may start to negatively affect the value of older properties.

It may also be that as the cost of robot-built housing continues to fall – and the time taken to complete each new home steadily reduces – the overall value of housing may enter a long decline. Scarcity of housing stock has been a major driver of high property prices in many countries. But whether this happens or not will depend upon availability of building land and national and local government policy.

It will not only be 3D-printed houses and homes which drive down the cost and build-time of residential construction. Conventionally-built homes which use bricks, tiles, wood, etc. as construction materials will also be much cheaper and faster to build in 2040 because they will mainly be built by robots.

Robot bricklayers that can lay bricks five times faster than humans have already been demonstrated. Other construction robots operating today include robot plasterers, robot labourers and robot diggers. By 2040, robots with infra-red vision will be labouring 24 hours a day (if there are no local noise and working restrictions) to build houses which will cost a fraction of the price of today's new-build property.

What To Expect in a Smart Home of 2040

The security system which protects the smart home of 2040 will be based on the occupants' biometrics. Cameras will be placed all around the property and in every room (in bathrooms, only medical diagnostic cameras will be fitted – see below). Facial-pattern-recognition (FPR) software will scan images of humans and pets (pet recognition software) outside and inside the property at all times.

When authorised occupants approach the property, FPR software will identify them and the appropriate door (or pet flap) will be unlocked by the system and the door will be automatically opened. The camera system will have infra-red capability for use at night-time and in low-light.

When FPR cannot be used, e.g. if an authorised occupant's face has been bandaged, back-up biometric authorisation technologies will include iris scans, voice-recognition systems and fingerprint recognition.

Inside the house, FPR systems will identify all occupants and know where they are at all times – unless owners wish otherwise.

When the property is empty, householders will be able to check on their home – room by room, if required – from wherever they are in the world. This data will be supplied to the owner's preferred data interface – e.g. smart contact lenses, smart glasses, to a portable projection device or to a portable screen.

The data an owner can access remotely from a smart home will be rich and layered. The top level of data will merely provide security information – 'everything is as it should be'. But if they wish, owners will be able to dig down more deeply into the household data set. This information will include the ambient temperature in each area of the house, the air quality levels in each room, the current energy consumption of each room and of each device within each room, outside climate details and weather forecasts.

The new home of 2040 will be a digital fortress, but hackers must never be underestimated

'Burglars' of 2040 will be hackers rather than opportunistic criminals and it will take very sophisticated computer skills to enter smart homes. But, if unauthorised physical entry is made, it is likely that independent back-up systems such as motion sensors will provide additional layers of security.

But it is unlikely that thieves will be targeting household goods in 2040 – all will be connected to the IoT and all will be easy to trace. More likely, criminals will target data held within smart home network hubs, although it is likely that by 2040, quantum encryption will be in widespread use and systems will be far, far harder to hack into than today's computer networks.

Fire, smoke, gas and CO2 alarms will be built into every room in new-build housing and, although connected to the main house network – and then to household occupants remotely – they will also have completely separate connections to the emergency services.

The new home of 2040 will be a digital fortress, but hackers must never be underestimated. If quantum encryption is in widespread use by this time, then we must expect hackers to be applying artificial intelligence techniques to launch assaults on home networks. Only vigilance and constant attention to data security will ensure the digital fortress remains secure.

Daily Living

Life in the smart home of the mid-21st Century will be very different from the way most of us live today. Here is how a typical day might begin:

"So, how am I this morning?" you ask the mirror in your bathroom. It is the first day of February, 2040.

"You're good to go, Maria," your virtual assistant Mark answers in your ear. But you've already guessed that. The diagnostic systems and sensors built-in to your bedroom and your bathroom have been monitoring you and carrying out silent and invisible medical checks while you slept, as you got out of bed, used the bathroom, took a shower and began to prep for the day ahead.

You would have already been told if there was something unusual in your sleep pattern, in your gait, if the analytical and diagnostic systems in your toilet had found something unusual, if your toothbrush had detected a fever or something suspect in your breath, if the bathroom mirror had spotted any signs of cardio-vascular problems or if the house air management system had detected unexpected bacteria or viruses. And, of course, your own body-network has been constantly scanning and recording your vital signs – and communicating that information to your domestic network hub.

But you ask Mark (your VA) the question anyway. It feels good to hear a friendly voice in the morning.

"Thanks Mark," you say as you pad into the kitchen. The coffee is already brewed, and the retractable counter-top robot arm is holding out the cup with your latte done just the way you like it.

You take the cup and the arm retracts back into the counter-top smoothly and silently.

You nod at the wall and it fills with a live TV news transmission. With a shake of the head you change the display to a curation of printed and video news stories.

"Smoothie or something else?" asks Mark in your ear bud.

"The usual," you say, and another composite robot arm glides up from the counter-top, takes a tall glass from the cupboard and starts selecting fruit and berries from the fruit bowl.

Another day of robot-assisted living has begun in your smart house.

Living with Robots

It has long been a science-fiction fantasy that one day we will have robot butlers and robot maids, but almost all of the illustrations in books and films of the past depict such robots as being android in form – mechanical humans. But that is not how the robots which will serve you in your smart home of 2040 will look.

Almost every room in the house will have simple, dedicated, single-purpose robots which do repetitive jobs so that the human occupants don't have to. Robot technology and software has already advanced to the point that we can now be confident that by 2040 we will have safe, inexpensive, 'soft' robots that will carry out most household chores.

In the kitchen, there will be robot arms that will select, wash, chop and prepare meat and vegetables.

And there will be robot chefs than can follow recipes precisely and make any dish, using smart, connected ovens and cookers that can be turned on remotely and which know themselves which temperature to use and which sense when cooking is complete.

After you have eaten, robot arms will scrape, rinse and load dishes into a dishwasher (essentially the dishwasher will load itself, wash the plates, cutlery and glasses and then will empty itself and re-stack the cupboard shelves).

Retractable robot arms will spray and clean counter tops and other surfaces and a small mobile robot will wash and clean floors automatically (when humans aren't present). And, of course, your smart fridge will monitor the freshness and quality of the food it stores and will re-order supplies as required, paying for them with your preferred type of digital payments system.

In the living areas of the smart home there will be robots that vacuum and dust and which clean windows. And mobile robots will fetch drinks and other items on demand – the closest we will get to a robot butler by 2040.

And the robots in the smart home of 2040 will be more than mere mechanical servants. Following pioneering experiments in Japan, we now know that tactile and talking robots can provide companionship for the lonely, comfort to the elderly and playmates for children.

Although most domestic robots will be single-purpose inanimate servants that won't take humanoid or animal form, those robots built to provide companionship or personal assistance are likely to look like pets These devices will encourage humans to think of them as being sentient and our powerful desire to anthropomorphise non-human objects will prompt people to create strong emotional bonds with their robot companions. This trend is likely to develop to the point that some people will think of themselves as being 'in a relationship' with a robot.

In the bedrooms, there will be robots that can pick up clothes, fold them and put them away. Other robots will pick up toys and put them away and robotic beds will make themselves. For the elderly, disabled or unwell, robots will provide assistance with getting in and out of bed.

In utility areas of the smart home, there will be robots that can empty and refill pet litter trays and robots that can select clothes for washing and put them in the washing machine (and, of course, take them out after washing and put them in the dryer). Another special-purpose robot will then do the ironing and yet another mechanical helper will take the clothes, fold them and put them away for you. There will even be a robot for sorting trash ready for recycling, and the same robot will also be in charge of the smart compost system for biological waste.

In the utility area of many homes of 2040 there will be 3D printers that can manufacture clothes on demand

Also in the utility area of many homes of 2040 will be 3D printers that can manufacture clothes on demand. New clothing designs will be downloaded, and garments will be produced as and when required – and they will always be a perfect fit .

And every electrical circuit and every pipe in the house will have pre-emptive maintenance sensors embedded that are on the look-out for failing taps, pumps, bulbs, electrical circuits, electrical appliances, robot components, etc. and which will prompt the house's control hub to seek the householder's approval to call a tradesperson to make repairs before a malfunction occurs.

In the garden, there will be robots for cutting the grass, raking and collecting leaves, weeding flower beds clearing snow from the driveway and even cleaning your barbecue grill.

And there will be a robot greeter inside your front door, ready to accept deliveries from expected and authorised delivery services when you are away from home. The greeter robot will even provide an electronic 'signature' to acknowledge the delivery of the item and will let the householder know it has been delivered.

Smart Home Energy Management and Environmental Control

The smart home of 2040 will use 75 per cent less energy and only one-third of the water used in a typical new home today. And used 'grey water' (e.g. bath or shower water) will be recycled, either for use in applications that do not require fresh water, or sent to a purification unit to be filtered and made fresh again. More than 80 per cent of the water used in the typical home is not used for drinking.

Depending on geographical location, new homes which have moderate sunshine, wind or geo-thermal energy sources available will actually collect more energy than they consume and will be selling electricity to the power grid .

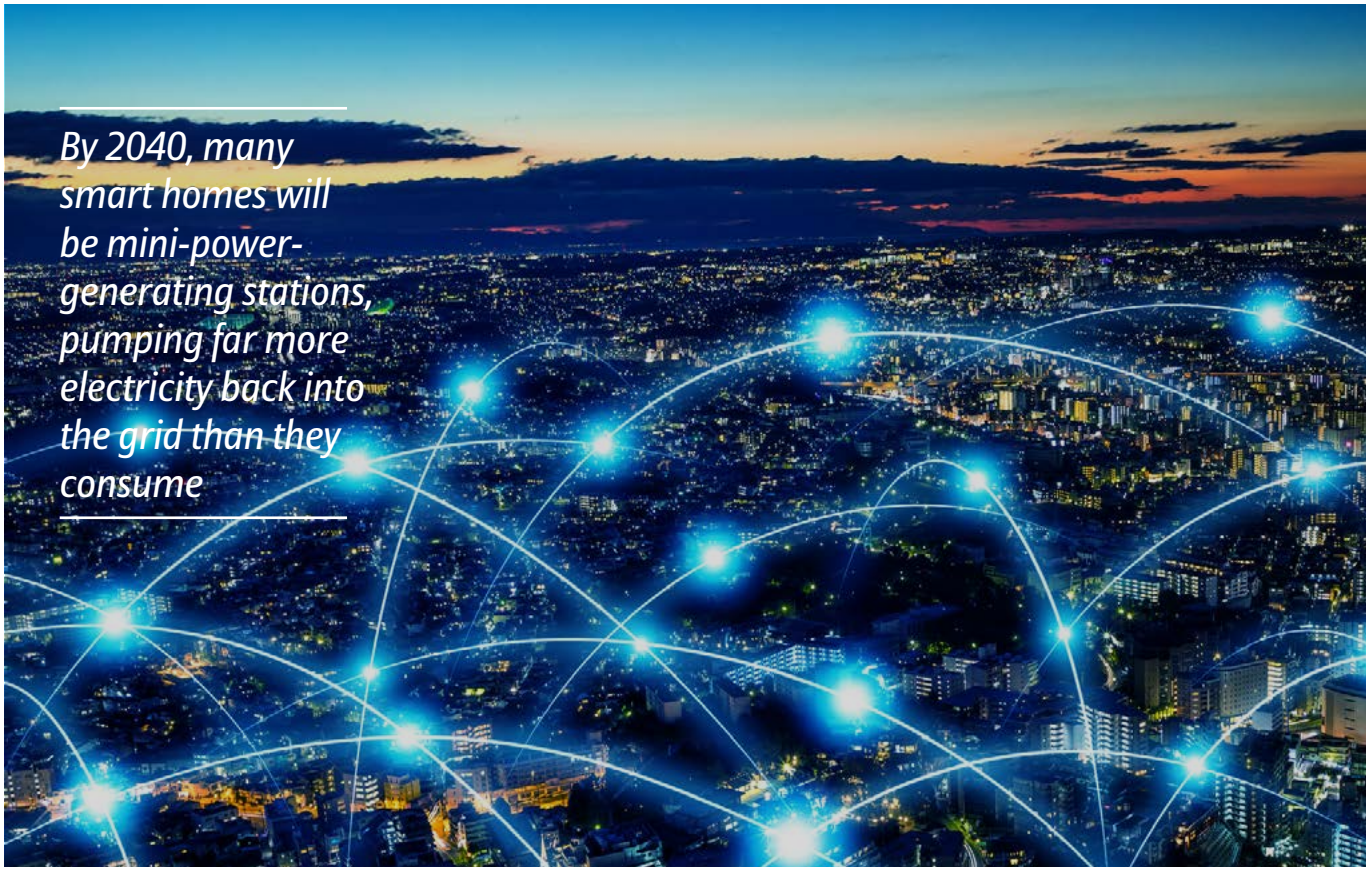
The concept of the super-efficient 'passive house' – a design for ultra-low energy buildings that require little energy for space heating or cooling – was pioneered in Germany in the early 2000s and has since been developed in various experimental locations.

The Japanese company, Honda, has built a smart house on the campus of the University of California, Davis. Inside this experimental home, an automated and energy-efficient LED lighting system helps to regulate humans' sleep-and-wake cycle by adjusting the brightness and warmth of the lights to mimic the shift in natural lighting throughout the day.

The house is also equipped with an energy management system that researchers created to monitor and manage its energy production and consumption. And although it's connected to the electrical grid, the dwelling produces more energy than it uses throughout the year, making it a 'zero net' home.

For the house's occupants, an iPad app provides control of the lighting, the entertainment system, the charging of an electric car in the garage and the opening and closing of the window shades. They can also check the solar energy production, the charge level of the house's domestic battery pack and individual room temperatures on the tablet.

But the smart house of 2040 will not be controlled by tablets and apps. Speech recognition will be accurate and reliable and speech comprehension will have advanced to the point that allows residents to control their environment simply by issuing natural-language spoken commands.



Bath tubs will fill (at the desired temperature), curtains will close, lighting will change, room temperatures will be adjusted, food will be made, drinks dispensed, and the place will be tidied up when the occupants simply ask for it. And air quality will be monitored and managed throughout the house, with filters removing up to 99 per cent of particulates from the air. And researchers are now confident that, if householders wish, they will be able to command the technology in a smart home merely by thinking about it.

By 2040, many smart homes will be mini-power-generating stations, pumping far more electricity back into the grid than they consume – but their roofs won't necessarily be covered by today's solar panels. Clear transparent glass – that looks just like conventional window glass – will contain super-efficient photovoltaic cells that will generate electricity for the house's batteries.

Domestic storage batteries will lie at the heart of the smart house's energy efficiency. It will be battery storage which gives the house its power independence and which allows it to sell renewable energy back to the main grid.

Storage batteries for use in domestic dwellings first became available in 2016 and by 2040, it is likely that the technology will have improved to the point that they are both much cheaper than today's domestic batteries and will store much more power. It is also likely that the batteries of tomorrow will be able to be charged, discharged and re-charged many thousands of times without degradation.

Home Entertainment in 2040

With all of the additional time-saving technologies that will be available in 2040, people often wonder what we will do with the extra 'spare time' that is generated in our lives.

The answer is that entertainment and educational experiences will be so intense that we will spend a considerable amount of time in virtual pursuits. Today's technology outliers of this virtual world include multi-player online games and the richness of entertainment now on offer from Netflix, Amazon Prime and Hulu. By 2040, these virtual experiences will be based on 7G networks and will have become super-rich and totally absorbing.

With a single word of command, occupants of a smart house in 2040 will be able to turn their living area into a totally-immersive Holo-Cinema.

This theatre will combine virtual reality, augmented reality and holographic technologies to create stunningly realistic and immersive gaming, travel, educational, sporting and entertainment experiences. Humans will not need to wear any special glasses or headgear and will literally stand or sit inside virtual events as they take place around them.

All human senses will be involved. As well as sight and sound, sensations of scent, touch and taste will be delivered according to the 'script' of the experience.

For amusement and education, people will be able to interview and interact with life-size holograms of famous pop stars, sports stars and famous historical figures.

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AI systems will provide such 'personality holograms' (or virtual reality personalities) with a natural language interface so powerful that the virtual personalities will be able to react to unstructured questioning in almost any language. When talking to virtual historical figures, it will seem as if the dead have come alive again – and it be possible to interact with 'VPs' (virtual persons) at different stages in their lives. You might choose to ask a young Winston Churchill about his life as a war correspondent and ask an older Winston about his leadership during the Second World War (the AI systems will draw the answers from his published articles and books). Or you might want a young Elvis Presley, Judy Garland or Amy Winehouse to sing for you.

Those who love to play virtual games may well add hydraulically-powered 'gaming chairs' to the holo-cinema that will provide players will the physical movements and sensations associated with each game or experience. A trip into space or a fight with virtual vampires may feel so realistic that health warnings may need to be issued as players strap themselves into their hydraulic chairs. Undoubtedly, there will be worries about the amount of time people spend in virtual pursuits.

By 2040, all games, movies, serial dramas, travel shows, documentaries and educational programmes will be delivered on demand. Only news and sports will be transmitted live.

On The Way To 2040

Nearly all of today's homes that are fitted with some smart technology are retrofits, and they are not very satisfying or successful. It is fair to say that today's nascent smart-home technology market is really only attractive to geeks, early adopters, researchers and the very wealthy.

It is useful to be able to manage heating and air-conditioning systems remotely, and it is very useful to ensure a home is secure, but the facility to open and close curtains from an app does not appeal to most people.

The smart home of the future will develop slowly because building and retrofitting residential property is a slow and long-term process. But, by 2025, useful robots will start to appear built-in to newly-constructed property and, by 2030, the utility gap between newly-built high-tech homes and retrofitted legacy property will seem significant.

This is likely to affect buying patterns in the residential property market, but perhaps not as quickly as this survey of rapidly-developing smart home technology might suggest.

The development of the residential property market is highly politicised, taxed and controlled.

Governments earn a high percentage of their tax income from property transactions, levying annual charges and raising taxes when properties are sold or when owners die. For this reason, the introduction and speed of uptake of low-cost, robot-built smart housing will vary country-to-country, according to government policy decisions.

The availability of finance to both house builders and buyers will also play a major part in shaping the future property market. Lenders may be slow to appreciate the benefits of 3D-printed construction techniques which could mean that the smart houses of 2040 may still be of conventional physical construction, albeit with smart technology embedded within their structure.

The development of robot building has the potential to make truly smart housing much more accessible and more affordable

But robot labour will make both conventionally-built and 3D-printed smart property much cheaper to construct. By 2040, it is likely that 3D-building techniques will be used alongside conventional construction materials and, if governments allow, it seems clear that the development of robot building technology has the potential to make truly smart housing very much more accessible and more affordable for the general public.

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