Britainthinks
Insight & Strategy

National Cyber Security Centre

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NCSC

Smart Routers

Final report

britainthinks.com

Contents

01 Context and methodology

Research objectives

The NCSC wants to increase the quality of routers in the UK, as a key means of protecting consumers and households from the cyber security threat. However, at present, engagement with routers is assumed to be low. As such, the NCSC commissioned BritainThinks to understand:

How consumers think and feel about their router and the role it plays in enabling connectivity and enhancing their security	How to communicate 'added value' to consumers to drive uptake of smart routers and engagement security features
• How do they think about and interact with their home network and connectivity in the home? • How do they currently use their router? What do they think it does?	• What do consumers need and want from connectivity? • What is the impact of security on consumers' motivations? • How could NCSC messaging on routers and security impact consumer behaviour?

Methodology

To achieve these objectives, we took a mixed methodology approach, comprising two key phases:

Exploratory Phase

- Two week programme of digital ethnography with 30 consumer participants
  - 16 x female, 14 x male
  - 9 x from ethnic minority background
- Varying levels of use and understanding of technology
  - 11 x Early Adopters
  - 10 x Mainstream
  - 9 x Resistors
- Conducted 1st – 15th February

To understand views and experiences of technology, connectivity and routers

- Follow up depth interviews with 12 participants who took part in the digital ethnography
  - 5 x female, 7 x male
  - 4 x from ethnic minority background
- Varying levels of use and understanding of technology
  - 2 x Early Adopters
  - 5 x Mainstream
  - 5 x Resistors
- Conducted 15th –19th February

To gather a deeper insight into participants' views on connectivity and test propositions

Validation Phase

- 5 minute nationally representative quantitative survey of 2,000 online consumers, representative by:
  - Age
  - Gender
  - Region
  - Socioeconomic grade
- Conducted online
- Conducted 26th – 28th February

To validate findings from the qualitative phases

Key findings

1. **Connectivity is felt to be critical by all consumers,** with all key segments seeing it as a vital part of everyday life, and heightened further in the context of the Covid-19 pandemic**.** However, engagement with connectivity between devices in the home, and with smart home devices, is much patchier and more limited.

2. **All consumers expect smart homes to be increasingly important over time**, with a sense that this will bring both practical and emotional benefits, particularly when they think about the physical outcomes of smart technology. However, many have low understanding, and their feelings about it are mixed.

3. **There is a recognition that connected homes of the future could bear additional security risks**, particularly as consumers share more information about themselves, and given the interplay between digital and physical security. However, in practice, many are thinking about the more immediate impacts of problems with their home network (e.g. disruptions), and security concerns tend to be secondary.

4. **Consumers deem their router to be one of the most important devices within the home, yet they rarely interact with it**. Few have taken any active steps to select their router (rather, most receive it from their ISP), interaction is limited to times when problem occurs, and confidence to troubleshoot is low.

5. **There is very limited understanding of the full role and potential of routers**, both from the perspective of enhancing connectivity within the home, and consumers' cyber security. This leads consumers to believe they are doing all they can to keep their home network safe, though there is openness to hearing more.

02 Introducing the segments

Consumers can be segmented into three groups according to their attitudes towards and usage of technology:

Early Adopters

- Those who are **particularly engaged with technology**. They enjoy **keeping up to date with the latest technology trends** and ensuring that they have the **absolute best devices for their needs**. Early Adopters are excited to see where the world of future technology is headed.
- Based on the online survey, Early Adopters make up **20%** of the online population. They are more likely to be **male and aged between 25-54**.

Mainstream

- Those who enjoy and appreciate technology, however they **do not consider themselves to be experts** and **do not actively keep up with the latest trends in technology**.
- Based on the online survey, Mainstream users make up **63%** of the online population. The group is **evenly split by gender, and are more likely to be aged 55 and over.**

Resistors

- Those who are **less engaged with technology.** This can either be due to a **lack of knowledge and confidence in using technology**, or a conscious desire to **resist the latest trends.** They often **feel nervous about how fast technology is evolving** and prefer to do things the ‘old fashioned way’.
- Based on the online survey, Resistors make up **16%** of the online population. They are more likely to be **female and aged 55 and over**.

These segments have been defined both quantitatively and qualitatively for the purposes of this study. Please see the Appendix for these definitions.

CASE STUDY: Early Adopter – Matt*, C2, 28

Meet Matt*

Matt is a 28-year-old salesperson from Leeds. He enjoys keeping up to date with the latest developments in technology and new products on the market.

In his home, Matt currently has an array of devices including smart home devices such as a smart TV, smart energy devices, and an Alexa smart speaker. Matt enjoys the ability to control these things from his phone, including changing music and controlling the energy.

When he moved into his flat, Matt did some research into his router and is familiar with some of the features of it. He has set up his security protection and firewall to ensure that whilst he is working from home he is protected. He has also used his router to link up his phone and smart devices.

"I do spend quite a bit of time looking at new technologies and reading reviews to see how they could fit into the current set-up I have in the house, but also how much additional load it could put on my broadband."

Attitudes to devices

- Matt actively keeps up to date with digital trends but is eager to avoid falling into the trap of always buying the latest products. Instead, he undergoes research to determine what best suits his needs.

- Matt's most important devices are:
  - Samsung smartphone
  - Laptop
  - Alexa
  - Smart electricity and heating

Understanding of router

- Matt believes he has a fairly good understanding of what his router does – he proactively clears memory and data on a regular basis to keep it running smoothly.
- He understands that his router enables his devices to connect to one another.

Views of connected home

- Matt is very interested in the potential for connected devices to make his life easier and more efficient. He also admits to appreciating the novelty of some new technology.
- He thinks of all the devices in his home as being interconnected and part of a cohesive system.
- In the future, he'd like connected devices to learn his individual preferences over time, and to anticipate his needs.

Views of security

- Security is a top priority for Matt, who has concerns around his data being stolen or misused.
- He understands that he should make sure his router is protected. Matt regularly changes his passwords, and believes this alongside his existing firewall protection, is adequate. He is also careful about his online behaviour (e.g. using secure sites and passwords).

*Name changed

CASE STUDY: Mainstream – Jane*, C1, 40

Meet Jane*

Jane is a 40-year-old nurse from Wales. She has a number of devices to keep herself connected to other people, such as a smartphone and tablet, and recently purchased an Alexa smart speaker after being recommended it by a friend. She predominantly uses her devices to stay connected with her family and friends across the country but also for entertainment e.g. Netflix and Amazon Prime.

Jane has two children and needs her home network to work efficiently and to be secure. She understands the importance of security and has installed some child protection settings on her children's devices. As she is with a well-known brand, Jane trusts her internet provider to effectively protect her against any issues. She does, however, change her network password every few months as an extra protective measure.

"I don't spend a lot of time finding technology as I have most of the things I need. However, if I do need to make a purchase I will look for the best offer available to save me money/gain extra packages/gadgets."

Attitudes to devices

- Jane is interested in technology, but says it's not a priority for her to keep up to date with the latest gadgets and only makes a purchase if she feels she has a genuine need for it.
- Jane's most important devices are:
  - iPhone smartphone
  - Laptop
  - iPad
  - Alexa

Views of connected home

- Jane appreciates her devices individually but doesn't consider how they could link up. She knows her phone connects to her Alexa to play her music, but doesn't dwell on how this is done.
- In the future, she imagines functionalities such as voice activation, motion sensors and biometrics will become the norm, however, she doesn't feel these are that important to her life right now. She sees these things as luxuries but not necessities.

Understanding of router

- Jane has some idea of what her router does, but it's her husband who manages the internet at home so she leaves him in control of the router whenever they lose connectivity. She doesn't interact with it at all herself.

Views of security

- Jane feels security is very important and takes basic steps to protect herself and her children including parental controls and changing her password when she remembers.
- More broadly she expects the brands she uses (e.g. Apple and BT) to provide adequate security protection as they are well known and trusted brands.

*Name changed

CASE STUDY: Resistor – Raj*, D, 67

Meet Raj*

Raj is a retired builder from Essex. He is not that confident in using technology but sees it as an essential part of life and feels it is important for him to try and keep up. He often relies on his adult children to guide him on purchasing and setting up new technology.

He regularly uses his tablet and home computer to browse the internet and stay connected with his family. He sees technology as important but only wants to purchase the things that really make his life better.

When his latest router was installed, Raj did some research to understand what it does, but found it slightly complex. He knows it provides his internet connection but is not aware of any other features.

"Technology is important to me but not so important that I must have the latest gadgets. I would only spend time and money on something that would have a real use and would make my life better."

Attitudes to devices

- When purchasing new devices Raj spends a large amount of time researching these devices, as he is worried about purchasing something that will not last.
- Raj's most important devices are:
  - Tablet
  - Computer
  - Smartphone

Views of connected home

- Raj does not currently have any connected devices and does not think of his home network as a cohesive system.
- Although he is positive about the potential for technology to allow him to maintain his independence, he struggles to envisage what this might entail and has some concerns about devices 'listening' to him. He also feels very intimidated by the idea of having to set up new devices that all need to link together.
- The main thing he anticipates is not having any wires in the house anymore!

Understanding of router

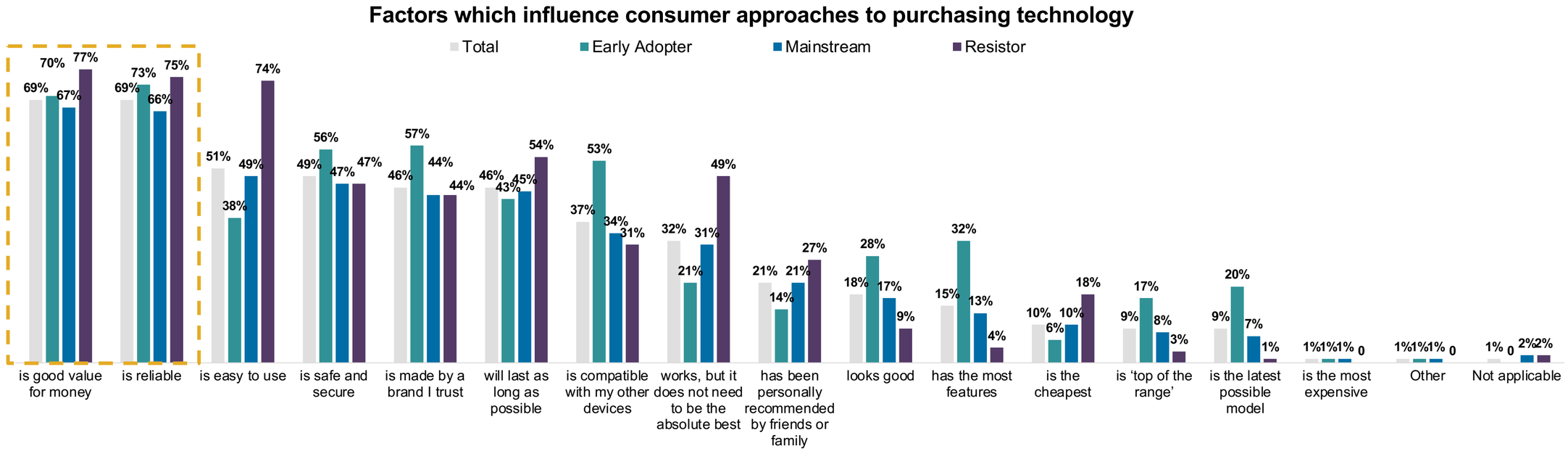
- Raj is aware of his router's importance in providing connectivity, but has little knowledge around features of the router itself or how to interact with it.
- He is unprepared to deal with unforeseen circumstances such as if his router stops working, and will call his children if he has any issues.

Views of security

- Security is important to Raj, but he feels very out of his depth trying to understand all the various threats and how to protect himself. He has avoided using online banking and having smart speakers due to security concerns that he does not know how to manage.
- He is confused about how routers link to security.

*Name changed

All segments say they choose new technology primarily according to value for money and reliability. Resistors are also particularly likely to prioritise ease of use.



Early Adopters are most likely to prioritise safety and security, as well as brand trust, aesthetics, features and compatibility with other devices, whilst Resistors are more likely than other segments to prioritise ease of use, longevity and the devices working as they should.

What factors, if any, influence your approach to purchasing new technology for you and/or your household? I look for/choose a model that… Please select all that apply. (Base n=2104)

All segments also say that they spend time researching new devices, but there is some nuance by segment within this

Early Adopters

Early Adopters say they heavily research new device purchases and/or continually keep up to date with new device releases and latest trends. They are happy to spend more money, but only when merited.

Early Adopters are more likely than other segments to be influenced by:

- Brands they feel they can trust (57%)
- Devices being secure (56%)
- Compatibility with other devices (53%)
- Devices with lots of features (32%)

"I don't tend to spend a lot of time looking for the right technology as I like to keep up with the latest devices and am willing to spend up to the maximum for the newest device."

(Early Adopter, 20, B)

Mainstream

Mainstream users represent a broad spectrum of interest in technology and desire to keep up with new devices and trends. However, they are united in their focus on finding the best value for money or the best deals when shopping for technology.

There are no factors which they are particularly likely to select as driving their decision-making behaviour in relation to technology relative to other segments.

"I don't always buy the most expensive and try and find a balance between features and value for money."

(Mainstream, 40, C1)

Resistors

Many Resistors say they spend a lot of time and money looking for the latest technology, often to compensate for their lack of confidence on the topic. Others are highly reliant on advice of family or friends.

Resistors are more likely than other segments to be influenced by:

- Ease of use (74%)
- Longevity (54%)
- What works, even if not the 'best' (49%)
- Recommendations (27%)

"My daughter usually recommends or helps me with accessing technology … as long as it works I am happy… when we chose our smart TV it had to be easy to for me to use and understand."

(Resistor, 67, C2)

What factors, if any, influence your approach to purchasing new technology for you and/or your household? I look for/choose a model that: (Base n=2104)

03 Connectivity and the connected home

Connectivity is important to consumers from all segments, and understood by most (though often at a relatively basic level)

Connectivity is embedded in daily life for most. This includes Resistors, who may have previously been hesitant, but say they have adapted so as not to be left behind.

Early Adopters

Early Adopters tend to have a **more advanced understanding of connectivity** – i.e., that it enables them to connect with others and the outside world, but also **connects their devices to give them a more seamlessly integrated life at home**.

"Technology is really important to me, I aspire to have a smart home that makes our lives easier and just make things far more convenient."

(Early Adopter, 40, B)

Mainstream

As well as enabling connection between themselves and others, connectivity is typically seen by Mainstream users to play a role in **sharing information across devices.** However this is often in relation to remote access through the cloud.

"It is very important to me that my devices are connected to the internet, remote access is very important for things like my document files and security system."

(Mainstream, 40, C1)

Resistors

Resistors tend to have a simpler understanding of connectivity. They typically see it as **a tool to keep them in touch with friends, family and the outside world,** but do not fully understand the idea of connecting devices or information.

"Without connectivity it feels like the world has stopped. Everything is much more difficult, it takes longer."

(Resistor, 56, E)

The reliance on connectivity (particularly the interpretation of ensuring connectivity with others) is felt to have increased during the pandemic due to its vital role in facilitating and maintaining 'normality' across socialising, working and entertainment.

The loss of connectivity is therefore extremely disruptive for all segments, both practically and emotionally

Practically, a loss of connectivity can significantly disrupt daily life

- This is particularly significant in the context of lockdown, as working and studying may be disrupted.
- Consumers are also often concerned about impacts on entertainment, as services such as Netflix and Amazon Prime become unusable.
- There can be strains on data and finances if consumers start to rely on devices such as smartphones which do not require a Wi-Fi connection to operate.

"The impact of this (network going down) ranged from minor things like the radio stopping or a film/TV programme buffering for a few minutes to more important things like online business meetings being interrupted or stopped completely."

(Mainstream, 40, C1)

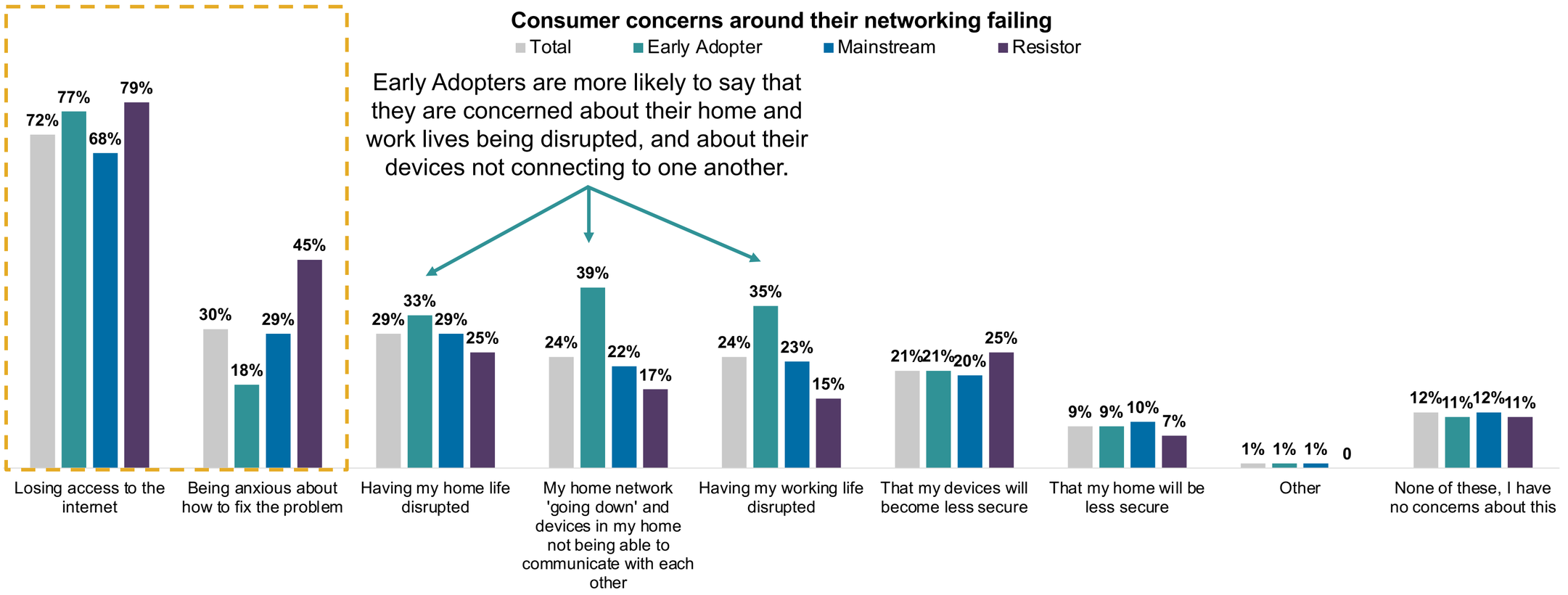
Emotionally, it can leave consumers feeling stressed and helpless

- Consumers report that the result of losing connectivity can be 'chaotic' in the home, particularly while there is little clarity on how or when the issue will be resolved.
- Disrupted work or studies can cause stress, whilst loss of entertainment and social tools leaves consumers feeling bored and disconnected from the world.

"The impact of not having connectivity would be quite disastrous. It would make me feel uneasy and worried."

(Resistor, 67, C2)

Losing access to the internet is a top concern for all segments, but fixing the issue is particularly worrying for Resistors

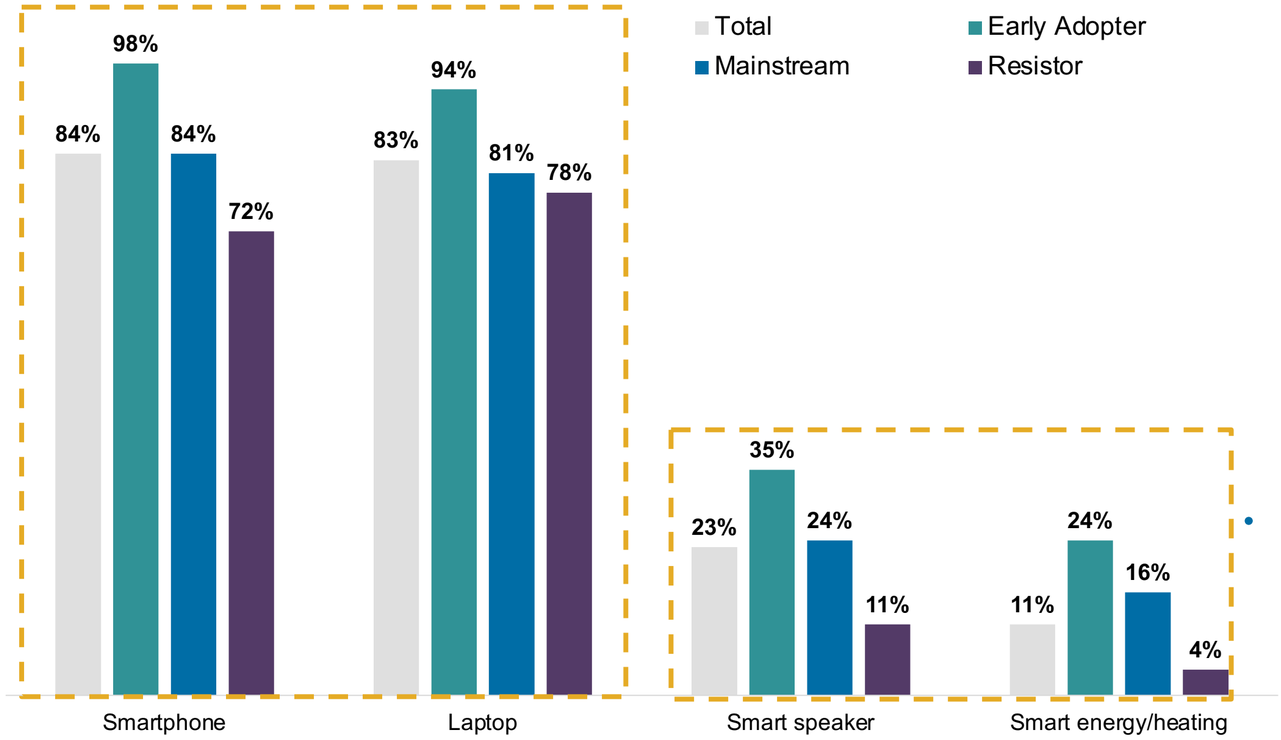


Please think about your own home internet connection and/or home network. What concerns, if any, do you have about this potentially failing or not working as well as it should? (Base n=2104)

Although all segments have fully embraced mainstream technology, ownership of smart/connected devices is both lower and more mixed

- Across all segments, high proportions of consumers claim to rely on smartphones and laptops.
- Resistors are the only segment which see laptop computers as more important to them than smartphones.

Ownership & claimed reliance on devices (own and (somewhat) rely on)



- Smart devices such as speakers or energy and heating controls are claimed to be used far more by Early Adopters than by other segments, particularly Resistors.

Q.2 Listed below are a range of different types of technological products or devices which you may or may not own and use. (Base n=2104)

In this context, Early Adopters are the only segment which spontaneously sees their home network as cohesive and integrated

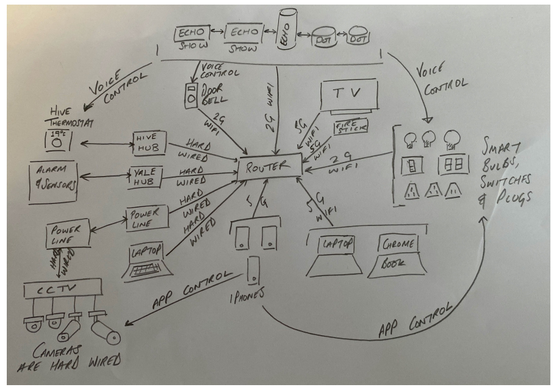
When asked to draw a diagram of their in-home network, the level of detail and devices included in the diagrams demonstrate differences in the segments' underlying knowledge of their home networks, but also their confidence in their network.

Early Adopters tend to see connectivity as a web-like framework with the router at its centre, and interactions occurring between devices. They also give far more detail.

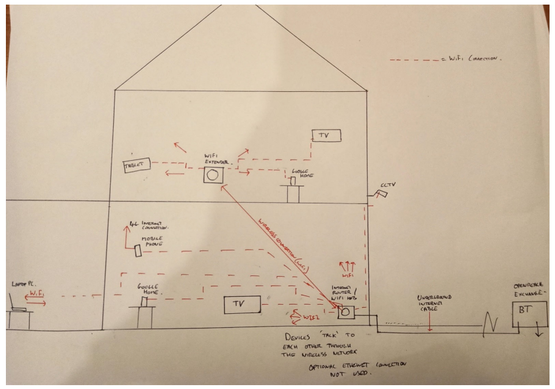
Mainstream users often show some connections between devices, but still seem them as separate rather than one integrated network.

Resistors are more likely to think of their devices being separately connected to the internet, rather than interacting with one another.

Early Adopter, 40, B



Mainstream, 40, C1



Resistor, 35, C1

Looking to the future, there are significant discrepancies in how the segments feel about the potential of technology to improve daily life

Early Adopters

100%

are very excited about the potential for technology to improve our daily lives

“Having a positive effect on my life, less things to worry about on a day-to-day basis.”

(Early Adopter, 32, C1)

Mainstream

42%

are very excited about the potential for technology to improve our daily lives

“Making life easier. Convenience in terms of safety and taking away those annoying tasks that get put on the to do list and don’t get done.”

(Mainstream, 31, C1)

Resistors

20%

are very excited about the potential for technology to improve our daily lives

“I have great concerns about the future and technology… I can just about cope with things as they are.”

(Resistor, 67, C2)

To what extent do you agree or disagree with the following statements? “I'm very excited about the potential for technology to improve our daily lives”. n=2104, base = all

On a broad level, most consumers anticipate that connected homes will mean less for them to do and think about

Having been primed to think about connectivity over a two-week digital ethnography, participants were asked to imagine their dream connected home.

The vast majority of participants could imagine a near future where a connected home could make their lives easier (if not more enjoyable). Specific functionalities were consistently raised that could improve their daily lives:

Potential use cases

Household tasks

Tedious manual household tasks like cooking, cleaning, feeding pets and watering plants, or time-consuming administrative tasks.

Automated adjustments

Adjusting settings like lighting and heating according to time of day, the preferences of the room occupant, or whether the room is occupied.

Reminders

Syncing with the household's calendars and giving reminders of events or prompting for certain items to be replenished if running out.

Biometric access

Eliminating the need for keys, wallets and passwords through biometric recognition at the front door, when making payments, and interacting with devices.

These are expected to be fulfilled by a range of functionalities:

- Voice activation
- Automation
- Motion detection
- Biometric access
- Security monitoring
- Health monitoring
- Energy efficiency
- Centralised controls
- Machine learning
- Anticipating needs

Consumers expect these developments to provide a range of emotional and functional benefits

Functional

Expected benefits include:

- Safety and security.
- Lower utility bills through greater efficiency (e.g. heating only being on in the rooms that are occupied).
- More physical comfort in the home (e.g. through ambience and mood settings).
- Fewer deliberate adjustments needed to keep the home running smoothly and to optimise the environment (e.g. heating and lighting).
- Fewer household tasks to do, and greater ease and convenience in the tasks that remain.

Emotional

Expected benefits include:

- Peace of mind through taking care of daily tasks, giving reminders, providing security, greater visibility of potential threats to the home.
- Greater wellbeing through more leisure time.
- Greater emotional comfort through optimising the environment and adapting to personal preferences.
- Greater independence, particularly for older people and those with accessibility issues.
- Greater sense of control and visibility over all elements of the household.

When imagining the connected home, consumers go on two conceptual “journeys”

Many feel that greater connectivity therefore needs to deliver across both these ‘dimensions’

Through time

Alarm goes off in the morning which sets the shower to heat up and the coffee to be made.

Sun sets, so blinds go down, ambient lighting transitions to evening mode.

Through space

Pull up in the driveway, facial recognition opens the garage and unlocks front door.

“The house is automated, The kettle goes on when you wake up. There’s ambient lighting to not affect your eyes, it’s in morning mode. Evening mode has adapted lighting.”

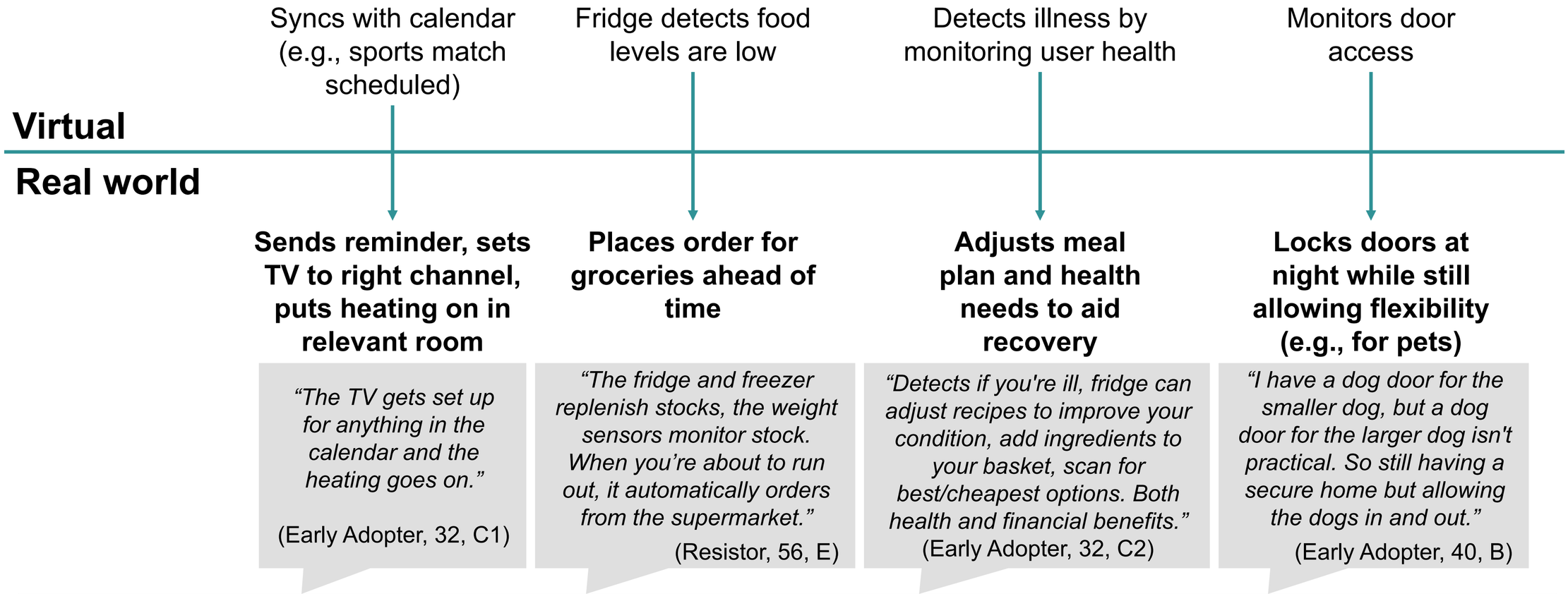
(Early Adopter, 36, B)

Lighting and heating turns off as leaving one room, and turns on when entering the next. Music follows should users move to another room.

“Hands free unlocking front door via face recognition. From the drive it recognises your face and asks for a pin or face recognition on your phone. You don't have to touch doors so that you can take shopping inside straightaway.”

(Resistor, 56, E)

Additionally, while consumers understand connected homes function virtually, it’s the physical outcomes which are most important to them



However, exact expectations for future connected homes – and feelings about these expectations – vary across segments

Having been primed to think about connectivity over a two-week digital ethnography, participants were asked to imagine their dream connected home.

Early Adopters

- Early Adopters tend to expect technology to fully adapt to their needs and lifestyles, learning their preferences over time, giving them more time and a more seamless daily life.
- They expect to have to actively manage technology on a very minimal basis due to their assumption that the connected home has anticipated all their needs.
- They believe that all the necessary technology already exists, and that it just needs to become more accessible.

"The home learns my habits over time, and adjusts heating and lighting to my preferences. The house is more energy efficient. There's less to worry about, and more time for leisure."

(Early Adopter, 32, C1)

Mainstream

- This group tends to think about what will save time and reduce stress so that they can focus on the things they enjoy e.g. having more work/life balance and spending more time with their children.
- Automation is expected to make their lives easier e.g. making their morning coffee. They anticipate that settings and preferences will be able to automatically adjust according to who's in the room and the time of day.

"Making your life easier and taking away irritating admin tasks… The fridge monitors when you run out of something. Stuff that ends up at the bottom of your to do list."

(Mainstream, 31, C1)

Resistors

- Resistors either imagine just one step ahead e.g. fewer wires, voice activation throughout the home, *or* resort to Sci-Fi images of robots or implanted microchips.
- Their conception of connectivity remains attached to individual devices and connectivity, rather than imagining a cohesive ecosystem.
- They expect to have to actively manage technology on a very minimal basis to reduce effort and potential irritation.

"I have 2 robots who have a chip implanted in their heads. They are controlled by voice recognition. Each has a different task to do. One of them will make and serve drinks and food when we ask them and the other is to help with daily activities." (Resistor, 67, C2)

There are several barriers which consumers feel may influence their uptake of connected home technologies

Security threats and fears

The perception that connected devices will hold more personal data about them, and be more closely tied to consumers' physical security, means some feel that more connected devices in their network will increase their security risk.

Privad concerns

Increased data collection, in particular personal data collection (such as health data), raises concerns for some individuals about the potential for data to be sold on or misused.

Cost

Smart technology is still seen as inaccessible to many consumers and is therefore often assumed to be expensive. This is most evident amongst Mainstream users and Resistors who tend to know and understand less about what is available.

Low confidence

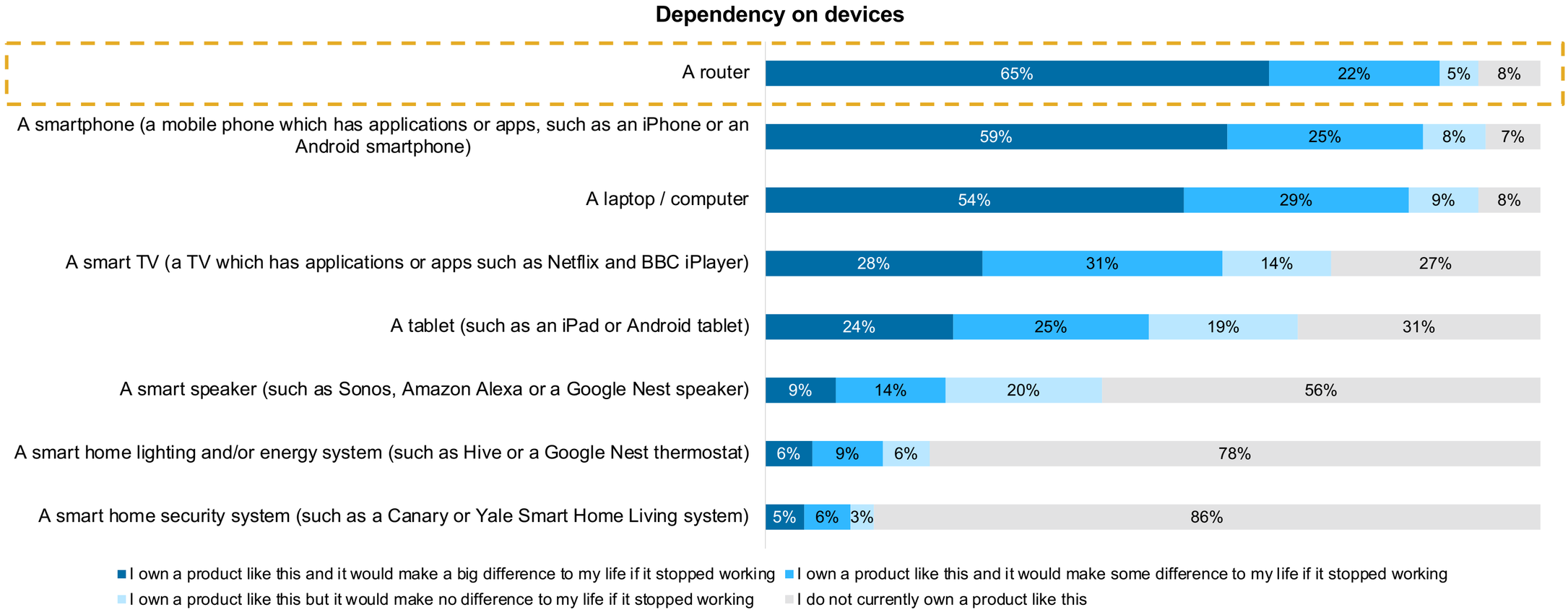
Many consumers (particularly Resistors) report feeling intimidated by the process of setting up their technological devices and often have to seek help in doing so. Connected and smart devices are assumed to have a more complex set up process.

Unreliable infrastructure

It's felt that the existing telecoms and electricity infrastructure in the UK is still inadequate to enable smart homes to function smoothly. This issue was raised by all segments.

04 Routers

Most consumers recognise that their router is an essential part of their home, and describe themselves as very reliant on it



Listed below are a range of different types of technological products or devices which you may or may not own and use. For each of the following products, please select the statement that best describes you. (Base n=2104)

However, beyond the initial set up, most only feel they interact with their router if a connectivity problem occurs

Proactive interactions with routers are limited

- For most, the initial set-up is the main point of interaction with their router.
- As part of the set-up process, consumers are often prompted to complete steps such as changing the password and the network. These are more commonly seen as a way to stop others using their Wi-Fi as opposed to being a specific security measure.

"I rely on my provider to make sure my router is safe. If there are any security issues I trust them to rectify it."

(Early Adopter, 33, C2)

Instead, most only engage reactively

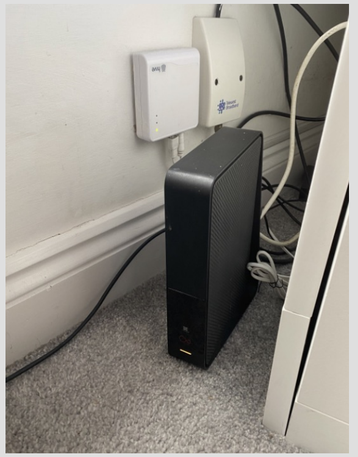
- Once a router is installed, there is little interaction with it across the segments.
- Most say they only engage with their router if a functionality issue (poor or unstable connectivity) occurs.
- A good router is therefore seen to be one that works effectively in the background with no input from users.

"I don't physically use my router, I often forget it is there unless there is a connectivity issue."

(Mainstream, 26, C1)

Digital Ethnography: 'Take a picture of your router' task

- *Most participants knew immediately what their router was and where it was located.*
- *However, a few Resistors did not know where this was, and described this responsibility as being their partner's or other family member's.*



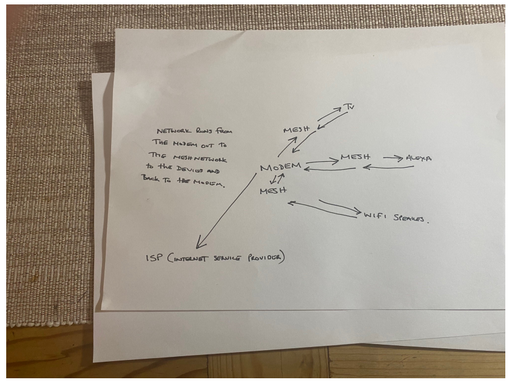
Routers are rarely chosen specifically, but rather typically received as part of a broadband contract

- Although individuals across segments take time to research internet providers, this rarely includes looking into specific routers. The router is typically received as part of their broadband package.
  - However, some Early Adopters had purchased their own router, normally prompted by basic connectivity issues. They did their own research and relied on word of mouth recommendations within this process.
- Within a household, whoever is in charge of selecting the internet provider tends to become the ‘gatekeeper’ of ‘kit’ associated with that provider, including the router, meaning others defer to them should an issue arise, regardless of actual knowledge.

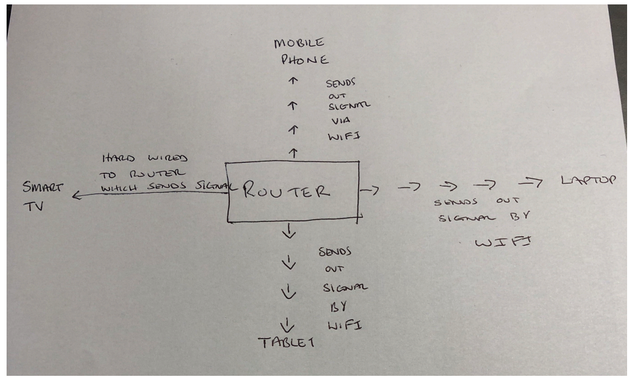
Early Adopters	Mainstream	Resistors
Most likely to have taken an active role in selecting their internet provider and router within the house due to their high technical knowledge.	Often have the task of selecting the internet provider delegated to them as part of the distribution of other household tasks and utility bills.	Most likely to have made decisions on internet providers with another member of the household, particularly if they live with another Resistor, to reassure them on their choice.

Consumers see routers as the central point that all devices connect to, but don’t always see its role in connecting devices

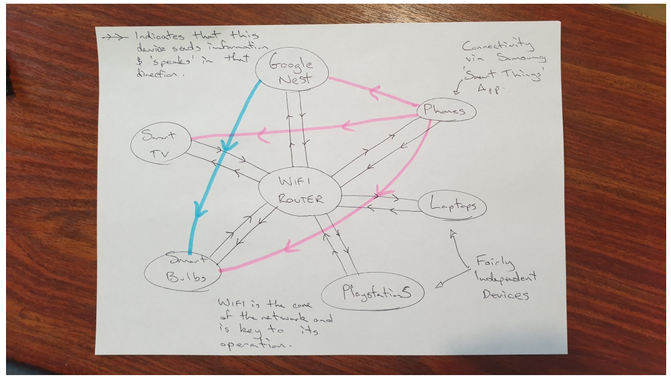
Resistor, 40, C2



Mainstream, 51, C2



Early Adopter, 32, C1



Resistors and Mainstream users tend to visualise the router as the central point within the home from which all devices connect to individually. Although some connected devices are featured on their diagrams of their home network, their interconnectivity and the router’s role within this are not highlighted.

Early Adopters are best able to visualise how connected devices operate together, but often still see this as happening outside the router, rather than ‘through’ it.

Most also don’t know the extent to which their router can influence connectivity in their home

- Connectivity is typically understood to be determined by supply to their home, rather than by routers themselves.
  - Issues with connectivity are often assigned to problems with their provider’s service or within a user’s local geographic area.
- Should a user face ongoing issues with their connectivity, they tend to say they would consider new broadband options, rather than a new router.
  - Only a minority of participants (typically Early Adopters) had upgraded their routers specifically, for functionality or aesthetic reasons.
  - For the majority, routers are not seen as an individual device but rather part of an overall broadband package.
  - Within this, there is an assumption that when they receive a router from their provider, it is likely to be of high quality.

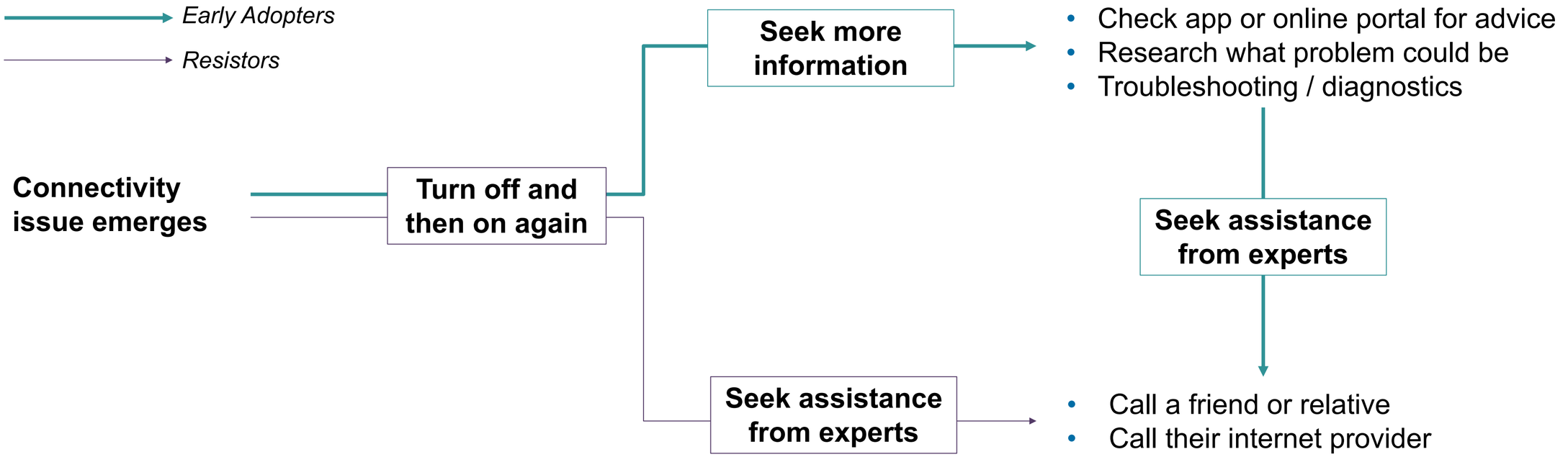
“I’ve been having issues with Virgin and these conversations have been making me think more about the kit that they provide.”

(Early Adopter, 40, B)

“I rang Plusnet to say what’s going on as the router they sent looked so cheap and horrible – they said I could still use my old BT router as Plusnet is actually part of BT.”

(Resistor, 67, C2)

Most can perform basic troubleshooting when things go wrong with their router, but need to outsource more complex problems



Early Adopters feel more confident in assessing and diagnosing the problem, but still ultimately lack the tools to fix problems if initial methods fail.

With no clear path to resolution, consumers easily feel a sense of powerlessness should they have issues with their router

Most consumers see their options as limited to:

Turning the router off and on again	Seeking out more information	Seeking assistance from 'experts'
The only solution to fixing connectivity issues that all segments feel confident on is turning the router off and on again. When this fails, they then become concerned about how to fix the problem quickly and easily.	Early Adopters feel confident in navigating information on connectivity issues and performing basic troubleshooting checks. However, this often gives them more information, but not a solution, leading to frustration.	Resistors and some Mainstream users may initially seek help from somebody they know. If issues persist, all segments eventually defer to calling the internet provider directly. This often leads to frustration due to long waiting times on the phone.

Confident → *Frustrated and powerless*

There is a strong preference across all segments for a self-help / DIY option that would allow them to identify and fix connectivity issues themselves more easily.

Consumers were presented with three propositions for routers of the near future:

Connecting devices together and to the internet

Keeping home devices up to date

Controlling access to online content at home

Consumers are drawn to the high level idea of security, but don't recognise the specific issue highlighted

Connecting devices together and to the internet

It may be useful to connect some devices to each other so they can share information (for example Smart or connected devices that may need to "speak to each other"). If so, it's a good idea to link these devices to each other in a separate group from the "main" network of all home devices, and some systems may be able to automatically create separate subnetworks in this way.

This means only the devices that need to be connected to each other are linked – so if a device is compromised in some way, the issue will be contained within this group of devices and will not spread through the whole network of all other connected household devices. Some home internet connections may be able to monitor internet traffic going in and out of the home and provide alerts for suspicious activity that may be unusual or risky, so action can be taken if needed.

If suspicious activity was to be detected, some systems may be able to intelligently isolate the device separating it from the network and limiting what it can communicate with, in order to reduce the potential for any harm to spread to other devices (even those on the same subnetwork).

- Awareness is low regarding the potential risks associated with connected devices should they become compromised, and the need to create a separate subnetwork to enhance security.
- Most consumers are highly receptive to the idea of their router being able to reduce security risks in this way, particularly if done automatically.
- However, this receptiveness predominately stems from a general desire to increase security where possible, rather than a recognition of the specific issue highlighted in the proposition.

"I imagine this would make things quicker as well and I guess it does give you more security if something fails. If something was compromised this would be a lot better for us. It sounds like it would take a lot of setting up but I would benefit from that. I don't think you would be able to see much benefit but it would make you feel more secure."

(Mainstream, 40, C1)

Security updates are understood as important, and the dashboard interface is particularly appealing

Keeping home devices up to date

It's good practice to ensure devices have up to date software and the latest software security updates installed. This helps protect them against known security vulnerabilities, keeping devices, information and data secure.

When a device is connected to the internet or to other connected devices at home, some systems may be able to tell if all the device's software is up to date, and then automatically update connected devices to the latest software version or stop them exchanging information with other devices if updates are no longer being released.

Some systems may also be able to ensure software updates are from a trusted source and only legitimate patches are installed (by using cryptographic mathematical codes that cannot be faked by a hacker, and comparing these across multiple sources, highlighting any discrepancies). It may be possible to view (e.g. in the system dashboard) the software status of all connected devices so that it is possible to, for example, isolate or remove any unsupported devices so that hackers cannot exploit any vulnerabilities they may have in order to access data, information or other devices.

- The need for devices to be kept up to date is understood by all segments, therefore security measures which help to ensure this are appreciated.
- In particular, a system dashboard for consumers to control themselves is appreciated due to some concerns about automatic updates:
  - Some would prefer to have manual control over when their software updates happen.
  - Some are concerned about how to reactivate devices should they be isolated or removed.

"I tend to want to choose whether to update, the danger is that it would automatically update and it would clog up the system, whereas when you are on a laptop you get a choice to update and it tells you what the update is for. I wouldn't want to always update the software, only the security updates."

(Resistor, 56, E)

Centralised parental controls are a reassuring feature – as long as tech savvy children can't intervene

Controlling access to online content at home

There might be different people using the internet connection and various connected devices within the home, so it's a good idea to consider who needs access to what and set controls on this accordingly (for example using parental controls settings on the system's dashboard).

Some systems may be able to allow internet access to be set for a specific group - blocking or limiting their access to specific types of online content (e.g. social networking or gambling sites) and/or limit time spent on a site or device (e.g. to prevent children accessing the internet after a set time or for more than an agreed period).

- Parental controls are already a well understood and frequently used feature – particularly amongst parents – either through the broadband provider settings or within specific devices.
- Although the feature itself is not new news, most would welcome a centralised place to set up controls across all devices. They feel this would give them a feeling of control and reassurance.
- A key aspect of parental controls working effectively is ensuring that they cannot be overridden (e.g., by tech savvy children), so many felt they would be looking for additional reassurance on this.

"Control is something that is lacking now with regards to internet. If I could set something up and then just have a dashboard for example saying his [my son's] computer would shut off at 11pm that would be great. If I had access to everything just pressing one device then it would be saving a lot of hassle."

(Mainstream, 41, C2)

When prompted to think about smart routers of the future, most consumers simply want additional ease and seamlessness

Functionalities:

- Many consumers stress a need for basic connectivity issues (strength and stability) to be resolved in future routers before more advanced features are considered.

- Beyond this, consumers expect to see routers supporting an array of features that could make their lives easier in terms of time, convenience and seamlessness. These reflect their ambitions for smart homes in general, and would ideally be controlled through one central system which could be accessed via a smartphone:
  - Enhanced physical security of homes e.g. high quality CCTV cameras, keyless locks, secure dog flaps, face recognition technology and sophisticated alarm services, ultimately creating the most secure home possible.
  - Heating and electricity that can be controlled by voice activation or smartphone, but are also responsive to changing external factors e.g., heating turns off once outside temperature increases.
  - Integrated devices that communicate to one another and understand your life and schedule, for example an espresso machine that turns on once a person's alarm has gone off and automatic reminders/prompts.

Aesthetic:

- As routers are often placed in prominent places within the house, many consumers note that they would like to see design improvements e.g. a device that looks modern and elegant and is generally unintrusive in appearance (no wires).

Security:

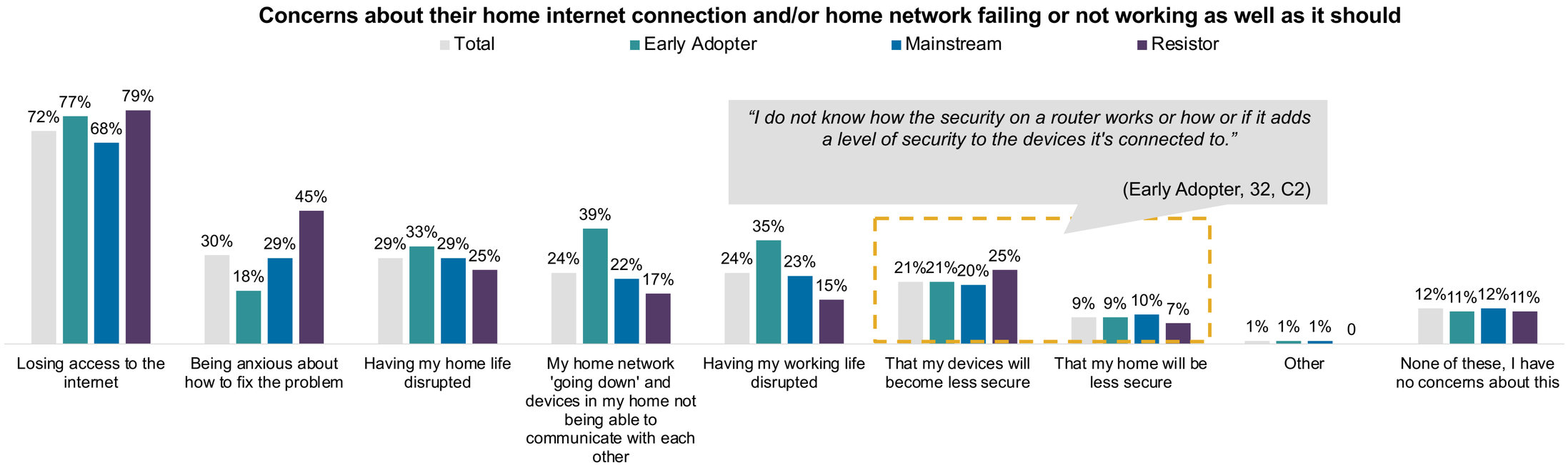
- Digital security is claimed to be a greater concern with smart routers, with questions around:
  - Data privacy: Smart routers would likely collect more personal data making users more vulnerable should this be passed on to third parties such as insurance providers.
  - Data security: Increased data collection also means there is an additional need for protection from hackers and breaches.
  - Physical security: The physical safety of homes and individuals could be compromised should smart technology fail.

- This means that additional layers of protection are expected, though most struggle to articulate what this would involve.

05 Security

Security is not typically a front of mind concern when consumers think about connectivity problems

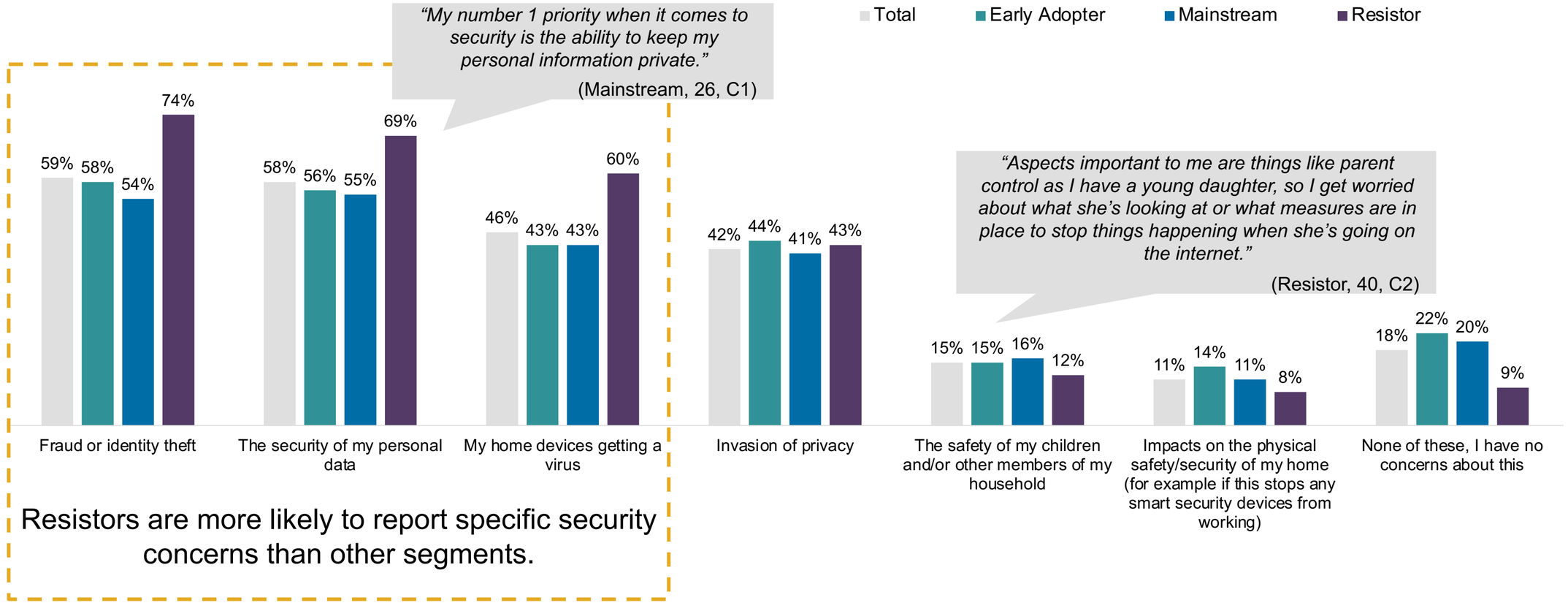
Security concerns tend to rank last when asked to consider the implications of the home network going down, and even causes some confusion for Early Adopters.



Please think about your own home internet connection and/or home network. What concerns, if any, do you have about this potentially failing or not working as well as it should? n=2104, base = all.

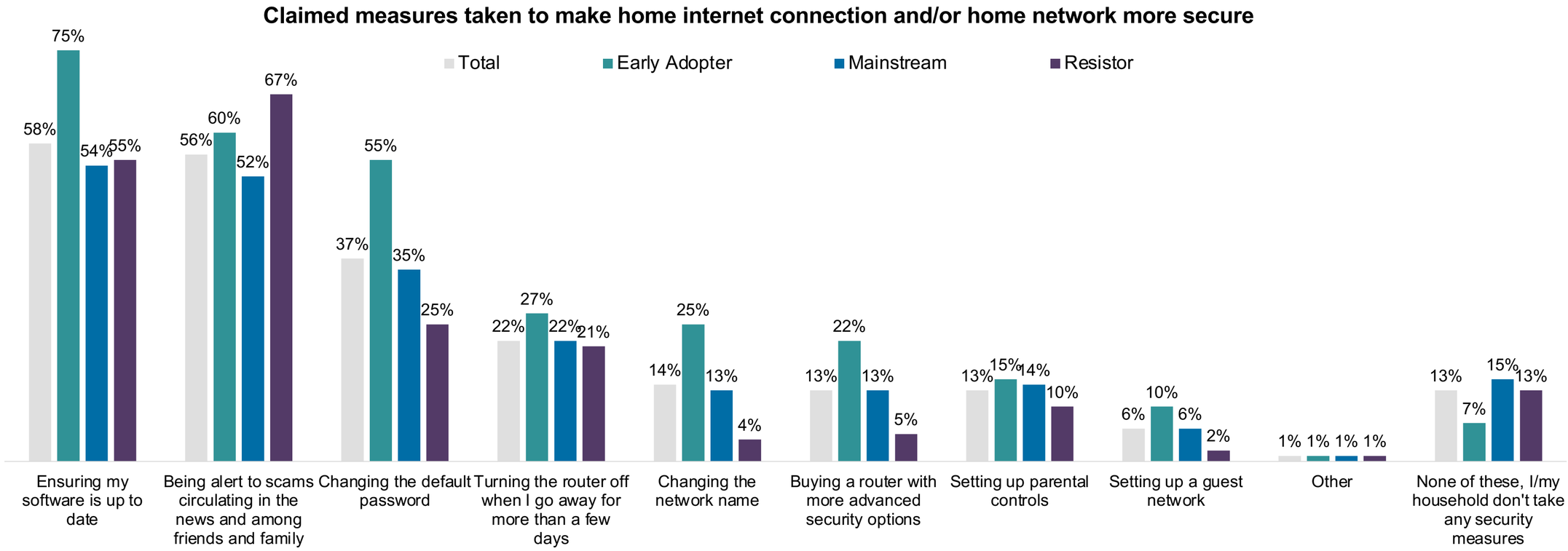
However, when asked directly about security in the context of their home network, consumers indicate an array of concerns

Security concerns about their home internet connection and/or home network failing or not working as well as it should



What security concerns, if any, do you have about your home internet connection and/or home network potentially failing or not working as well as it should? n=2104, base = all.

While most people do undertake some measures to protect their home network, security measures relating to routers are far less likely to be undertaken than behaviours such as software updates and vigilance



What measures, if any, do you and/or your household currently take to make your home internet connection and/or home network more secure? n=2104, base = all.

CASE STUDY: Early Adopter – Debbie*, D, 65

Meet Debbie*

Debbie is a care worker from Yorkshire who feels that the possibilities for technology are limitless.

She does, however, have some concerns about security, particularly her home network, as she is generally a very security conscious person, and accesses a lot of things online such as banking.

The precautions that she claims she takes include looking out for “https” to know that she is accessing a secure site. She makes sure that whenever she as logged into a website that she also logs out. She pays for additional security from her internet provider, which gives additional protection when she’s using mobile banking.

She doesn’t have any security concerns with her router because she hasn’t had any issues, but does turn it off when she goes away.

“Security of my information is very important to me, as I am generally a very security conscious person… obviously people could steal your identity your money and lots more besides, so I am very aware of being careful when using the internet.”

Understanding

- Debbie associates security more with online behaviour than hardware protection and so she makes sure that she uses secure links and encryption where she can.
- She understands that there are features in place such as firewalls and data protection services within her home network.
- She does feel, however, that the security measures that her provider has put in place (having paid more) are safe enough.

Habits

- Debbie is diligent in keeping her software up to date: she looks out for scams and phishing, and prefers to change default passwords to keep her home network safe.
- She pays for extra services from her internet provider for additional layers of security when she is managing any personal data online.

Trust

- She has high levels of trust in the brands that she uses for technology.
- She is very confident in her own ability to keep her home network safe, as she takes all the precautions that she thinks are important.
- She wouldn’t often ask for help or advice from people outside her household.

Router & security

- Debbie doesn’t understand the role of her router in keeping her home network safe in any detail, but does prefer to switch it off when she goes on holiday.

*Name changed

CASE STUDY: Mainstream – Ahmed*, C1, 57

Meet Ahmed*

Ahmed is a senior manager who lives in Buckinghamshire with his family. He loves travelling for both leisure and business.

Security is very important to him to protect himself and his family. He takes numerous measures including running anti-virus software on all laptops and desktops in the house, he's alert to spam emails and phishing, he regularly changes passwords, and backs up data to external devices and cloud storage. He uses fingerprint authentication where he can.

He admits that he doesn't know much about security and routers, but is reassured that password protection means that no one outside the house can use his household's Wi-Fi. He feels that regularly changing the router password provides very strong protection, but is concerned about how well this would stand up to hacking.

"Hackers these days have ingenious ways once they breach security to get into all sorts of devices… My concerns are we never know what loopholes there are in the system to allow our data to be compromised."

Understanding

- Data security is of high importance to Ahmed as he has concerns about data being stolen or misused.
- However, he assumes that the default settings on his router are sufficient for maintaining security. He wouldn't know how to change them or further protect himself.
- He is aware that he probably doesn't know as much as he could about the internet and security to fully protect himself and his family.

Trust

- Ahmed feels he has average trust in the brands that he deals with for all his devices and his internet service provision.
- He trusts himself to manage the home network's security as he feels he behaves in a 'safe' way online.

Habits

- Ahmed is fairly consistent at keeping software is up to date, but often puts this off. He feels savvy enough to spot scams and feels that regularly changing his passwords gives him a very strong layer of protection against potential threats.

Router & security

- Ahmed has virtually no understanding of the role of his router in security.
- He assumes that the manufacturer of the router has made sure it is safe and there's nothing further he needs to do.
- He feels secure day-to-day, but does feel somewhat powerless in the scenario that he is deliberately targeted by a hacker.

*Name changed

CASE STUDY: Resistor - Charlotte*, C2, 41

Meet Charlotte*

Charlotte is from Glasgow and works in retail. She has a 10-year-old daughter and loves cleaning in order to de-stress.

The security of the data on her devices is important to her. The most important aspect for her is parental controls as she has a young child. She worries about what she has access to. She also worries about security on her phone when accessing social media, and about getting hacked or getting a virus. Another concern is her bank details being compromised when paying for things with her phone.

The precautions she takes include setting up parental controls on her TV and her daughter's computer, and putting anti-virus software on her laptop.

She hasn't thought about security in relation to her router, and wouldn't know how to ensure her router is safe and protected.

"I don't know how to ensure router is safe and protected. I would think the company I got it from surely would have some security measures on it I'm guessing."

Understanding

- Data security is important to Charlotte, but her low understanding of technology and security means that she's not sure what more she can do.

Habits

- Charlotte is particularly alert to scams that she hears about on the news or through friends and family. She keeps her anti-virus software up to date but isn't sure of more concrete things she should be doing.

Trust

- Charlotte generally trusts the companies that she uses to keep her data secure, but does have underlying concerns about them failing to do so or potentially passing on her information.

Router & security

- Charlotte has no idea what role her router plays in the security of her home network.
- She assumes that her ISP (Sky) is taking care of her security as they are a well known brand.

*Name changed

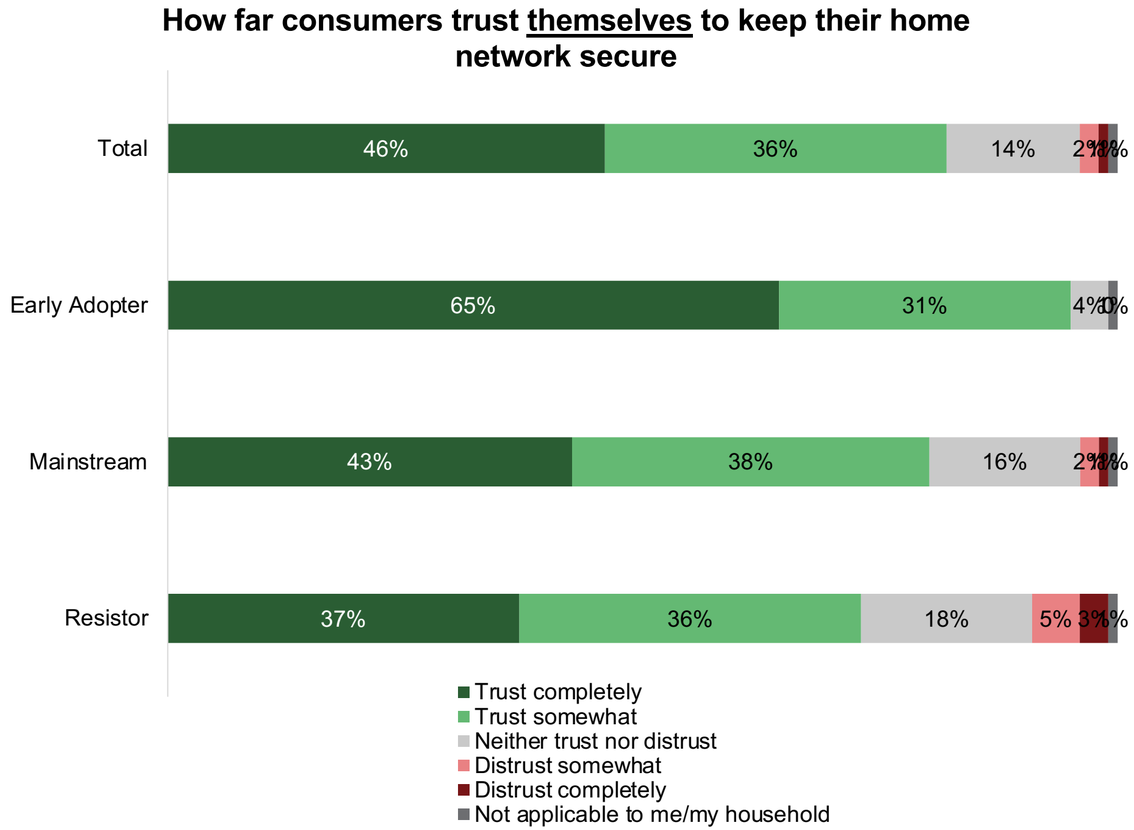
Consumers don’t do more to protect their home network because they haven’t had issues in the past, and trust their router’s security

Trust that their router already has protection in place	**42%** of consumers say they don’t do more to protect their home network because they **trust that their router has adequate security protection.**	*“I don’t do anything [to keep my data and devices secure when connected to the internet]. I rely on the broadband provider keeping data safe and secure.”* (Early Adopter, 40, B)
Sense that the threat is invisible and intangible	Many consumers feel they are **not aware of many potential threats, or their implications,** until they are impacted by them directly.	*“I don’t take security too seriously these days. It’s not very important to me as I guess I don’t know the implications of it not being secure.”* (Resistor, 37, E)
Belief it won’t happen because it hasn’t in the past	**35%** don’t do more to protect their home network **because they haven’t had security issues in the past.**	*“If [your lost/stolen device] is backed up all you need to do is connect to your internet and it would restore it. You don’t have to go through all the iCloud etc logins etc. I’ve had my phone stolen twice and that’s always a stress.”* (Mainstream, 31, C1)
Belief risks are about day-to-day behaviours	For many, security is perceived to be more about the **devices they use most frequently** rather than ‘background’ kit such as routers.	*“I do know my router is password protected and only I have that information and potentially my router provider. Therefore, if someone wants to access the internet from a device via my router they must have the password.”* (Mainstream, 26, C1)
Belief someone else is sorting it	There is a high degree of **willful ignorance** in order to avoid being proactive in managing security.	*“I understand my router has inbuilt systems to stop [viruses]. Because of this I have not bought any other virus protector or anything like that as years ago I did have it, and it was causing issues with the one that's already there.”* (Early Adopter, 49, D)

There may be reasons why you and/or your household don't do all there is to make your home internet connection and/or home network more secure, or reasons stopping you from doing these. n=2104, base = all.

They also tend to trust themselves and their belief that they are doing all they can – despite their low levels of knowledge in practice

- Consumers are almost twice as likely to trust themselves to keep their home network safe (82%) than home network brands, such as those that sell routers (42%).
- Differences fall out by segment, with Early Adopters particularly likely to trust themselves compared to Mainstream users and Resistors.
- Qualitatively, self-trust seems to relate to the fact that most consumers report taking *some* action to keep their networks safe, and that they can't easily identify what additional steps they could be taking.



How far do you trust or distrust each of the following people and organisations to keep your home internet connection and/or home network secure? n=2014, base = all.

06 Conclusions

Recap of key findings

1. **Connectivity is felt to be critical by all consumers,** with all key segments seeing it as a vital part of everyday life, and heightened further in the context of the Covid-19 pandemic**.** However, engagement with connectivity between devices in the home, and with smart home devices, is much patchier and more limited.

2. **All consumers expect smart homes to be increasingly important over time**, with a sense that this will bring both practical and emotional benefits, particularly when they think about the physical outcomes of smart technology. However, many have low understanding, and their feelings about it are mixed.

3. **There is a recognition that connected homes of the future could bear additional security risks**, particularly as consumers share more information about themselves, and given the interplay between digital and physical security. However, in practice, many are thinking about the more immediate impacts of problems with their home network (e.g. disruptions), and security concerns tend to be secondary.

4. **Consumers deem their router to be one of the most important devices within the home, yet they rarely interact with it**. Few have taken any active steps to select their router (rather, most receive it from their ISP), interaction is limited to times when problem occurs, and confidence to troubleshoot is low.

5. **There is very limited understanding of the full role and potential of routers**, both from the perspective of enhancing connectivity within the home, and consumers' cyber security. This leads consumers to believe they are doing all they can to keep their home network safe, though there is openness to hearing more.

These findings suggest that there are key opportunities to:

Action	Impact
Bring to life the full functionality of routers, both now and in the smart homes of the future.	Helping consumers to understand the variations between routers and their potential features and benefits will help them to see them as a standalone device worth engaging and investing in its own right.
Empowering consumers to better manage connectivity issues through their router when things go wrong (a key reason to engage).	Giving consumers more self-help tools to fix connectivity issues should they go wrong will not only reduce other negative impacts, but encourage consumers to take more control over their router.
Highlighting the importance of 'background hardware' for cyber security, particularly at key points of engagement (e.g. set-up).	Confronting consumers' complacency and belief they are doing all they can, and encouraging them to engage in further actions to improve the security of their home network.

07 Appendix

We included a broad range of consumers in the sample

30 consumers				
 **Age**	 **Gender**	 **Ethnicity**	 **Socioeconomic grade**	**Attitudes towards technology**
• 12 x 18-39 • 13 x 40-64 • 5 x 65+	• 16 x F • 14 x M	• 9 x from ethnic minority backgrounds	• B x 7 • C1 x 8 • C2 x 8 • D x 3 • E x 3	• 11 x Early Adopters • 10 x Mainstream • 9 x Resistors

Segments for the purposes of sampling were determined slightly differently in each phase:

Exploratory Phase

For the digital ethnography the recruitment screener segmented participants by the following:
(Minimum agree with two statements)

Early Adopters
- Tend to be the first to try technology.
- Technology as a main interest.
- Technology makes like easier.
- Prefer to have the latest models.

Resistors
- Technology can be a nuisance.
- Need support getting use to technology.
- Nervous about how quickly technology is evolving.
- Most comfortable doing things like banking in the old fashioned way.

Mainstream
- Have the same devices as friends and family.
- Don’t consider themselves an expert.
- Enjoy and appreciate technology but don’t have the latest things.
- Use technology to make life easier.

Validation Phase

For the Quantitative survey segments were split as shown:

Early Adopters
- **Agree** to actively keep up to date with the latest trends.
- **Agree** to doing lots of research before purchasing a new device.

(Disagree two out of three options)
- **Disagree** to only upgrading technology when needed.
- **Disagree** with needing help getting used to new technology.
- **Disagree** that technology can be a nuisance.

Resistors

(Agree three out of four options)
- **Agree** that technology can be a nuisance.
- **Agree** that they need support getting used to technology.
- **Agree** to only upgrading technology when needed.
- **Agree** to feeling somewhat left behind by technology.
- **Disagree** to keeping up with the latest technology trends.

Mainstream
- All other respondents.

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Insight & Strategy

Thank you

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