



Centre for
**Strategy & Evaluation
Services**



Impact Assessment on Increased Protection of Internet-Connected Radio Equipment and Wearable Radio Equipment

Annex 5 – Radio Equipment Forecasts

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Contents

1.	Radio equipment forecasts	1
1.1	Application category 1: Radio-frequency identification devices.....	1
1.1.1	Active RFID devices.....	2
1.2	Application category 2: Transport and traffic telematics devices.....	2
1.3	Application category 3: Smart home devices (alarms, telecommand and telemetry devices).....	4
1.4	Application category 4: Audio media wireless streaming devices.....	6
1.5	Application category 5: Remote monitoring and wireless alarm devices.....	9
1.6	Application category 6: Wideband data transmission devices.....	12

Tables

Table 1.1:	Passive RFID devices.....	1
Table 1.2:	Embedded vehicle anti-collision radar.....	2
Table 1.3:	Electronic fee collection devices.....	3
Table 1.4:	Alarm devices.....	4
Table 1.5:	Key fobs.....	5
Table 1.6:	Baby monitors.....	5
Table 1.7:	Garage door/gate openers.....	6
Table 1.8:	Wireless headphones.....	6
Table 1.9:	Media players.....	7
Table 1.10:	Wireless Speakers.....	7
Table 1.11:	Wireless microphones.....	8
Table 1.12:	Audio media wireless streaming devices overview.....	9
Table 1.13:	Utility meters.....	9
Table 1.14:	Social alarms.....	10
Table 1.15:	Distress alarms.....	11
Table 1.16:	Remote monitoring and wireless alarm devices overview.....	11
Table 1.17:	Tablets.....	12
Table 1.18:	Smartphones.....	13
Table 1.19:	Games consoles.....	13
Table 1.20:	Smart Televisions.....	14
Table 1.21:	Wearable devices.....	15
Table 1.22:	Virtual reality head display.....	16
Table 1.23:	Wideband data transmissions devices overview.....	16
Table 1.24:	Wearable Routers.....	17

1. Radio equipment forecasts

This standalone annex provides an overview of the application categories and key forecasts for radio equipment devices. To provide a readable and succinct summary, device overviews and forecasts are restricted to a single page.

The section covers six different categories (and excludes medical devices, as these are outside of the scope of this particular study). It covers more than 30 different internet-connected RE devices.

1.1 Application category 1: Radio-frequency identification devices

Radio-frequency identification (RFID) is a wireless technology, operating in a number of licence-exempt spectrum bands. RFID technology uses electromagnetic fields to transfer data, for the purposes of identifying and tracking tags attached to objects, animals or persons (e.g. automatic identification and data capture [AIDC]).

Table 1.1: Passive RFID devices

Source	Summary of findings
2008	RFID became commercially viable in 2005 with mass acceptance by 2010.
2013 ¹	RFID market is forecasted to increase at a CAGR of 22.4 per cent through 2018.
2015 ²	RFID was first invented in 1945 and patented in 1973. In the 1990s more advantages were recognised and by 1999 common standards were set up.
2015 ³	The RFID market is worth \$8.89 billion in 2014 and IDTechEx forecast for it to rise to \$27.31 billion in 2024. There were 3 billion RFID labels used in retail and 425 million tags in animal tagging in 2014. IDTechEx estimate that 6.8 billion RFID tags were sold globally in 2014
2017 ⁴	RFID tags should last for around 20 years
2018 ⁵	IDTechEx expects 16.4 billion tags will be sold in 2018. Most of this growth is from passive UHF RFID labels. This equates to 2.15 billion devices in EU28 Member States

IDTechEx estimate that 6.8 billion RFID tags were sold globally in 2014. They estimate the market in 2014 was worth €7.8 billion, increasing to €23.9 billion in 2020 (this would require CAGR of 10.8 per cent). IDTechEx suggests annual sales will reach 125 billion tags in 2020 (this would require CAGR of 50.4 per cent). If this growth rate was achieved cumulative global sales of RFID tags⁶ could be approximately 188 billion in 2020. Study calculations suggest this would equate to 24.7 billion in EU28 Member States in 2020.

From 2017 to 2020 the market is expected to grow by a CAGR of 8%. If this growth rate is maintained, the 2025 and 2030 values will be 36.3bn and 53.3bn for 2025 and 2030 respectively.

¹ Fierce Mobile IT. 2013. RFID market to increase at a 22.4% CAGR through 2018, says TechNavio.

<http://www.fiercemobileit.com/story/rfid-market-increase-22-4-cagr-through-2018-says-technavio/2013-12-12> accessed 9th April 2015

² Radio Electronics. 2015. RFID History. <http://www.radio-electronics.com/info/wireless/radio-frequency-identification-rfid/development-history.php> accessed 2nd April 2015

³ Research MOZ. 2015. RFID Forecasts, Players and Opportunities 2014-2024. <http://www.researchmoz.us/rfid-forecasts-players-and-opportunities-2014-2024-report.html#src=whatech> accessed 9th April 2015

⁴ RFID Journal. 2017. How often does an RFID tag need to be refreshed or replaced?

<https://www.rfidjournal.com/blogs/experts/entry?11948> Accessed 13th May 2019

⁵ IDTechEX. 2018. RFID Forecasts, Players and Opportunities 2018-2028. <https://www.idtechex.com/en/research-report/rfid-forecasts-players-and-opportunities-2018-2028/642> Accessed 13th May 2019

⁶ This assumes that half of tags from previous years are destroyed each year.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	3.7bn	24.7bn	36.3bn	53.3bn
Max market size by 2030	53.3bn	Date brought to market		2005

1.1.1 Active RFID devices

LE Spectrum 2.446 - 2.454 GHz

Source	Summary of findings
2008 ⁷	Active RFID became commercially viable in 1973 and utilised from mid 1980s, mostly in animal tracking and toll roads.
2011 ⁸	772 million active RFID tags have been sold to the beginning of 2010. IDTechEx expects the active RFID market will grow to almost 10 times its present size by 2020.
2015 ⁹	IDTechEx estimate that one per cent of RFID tags sold globally in 2014 were active.
2017 ¹⁰	Batteries generally have a lifespan between two and five years.

1.2 Application category 2: Transport and traffic telematics devices

Transport and traffic telematics (TTT) are a wide-ranging application category that covers devices and their interfaces, across all modes of transport, including road, rail, maritime and aeronautical. The TTT devices provide communication connectivity between vehicles (V2V or vehicle-to-vehicle) and between vehicles and roadside or trackside infrastructure (V2I or vehicle-to-infrastructure on roadside or trackside).

Table 1.2: Embedded vehicle anti-collision radar

LE Spectrum 5.795 - 5.805 GHz, 76 – 77 GHz

Source	Summary of findings
2012 ¹¹	600 million cars on the road will be fitted with an embedded telematics system by 2025. Over 90 million new cars globally will also be fitted with embedded telematics by 2025, representing a significant majority of total vehicles.
2014 ¹²	Global sales of anti-collision radars are forecasted to reach \$4.38 billion by 2020, from \$1.62 billion in 2014. Bosch expects its annual sales to average 4 million units in 2015 and 2016.
2014 ¹³	The number of new cars equipped with DSRC systems are expected to reach 26.1 million in 2024

⁷ Jones E.C., and Chung C.A. 2008. RFID in Logistics.

<https://books.google.co.uk/books?id=xCLpVMMbM8C&pg=PA117&pg=PA117&dq=active+rfid+tags+first+introduced+commercially&source=bl&ots=ZMe8JpPglw&sig=Fyhdn0P8QbZZDhnFgluSDaZpbt&hl=en&sa=X&ei=X8XtVKmGBJaxaYCVgYgC&ved=0CE8Q6AEwBw#v=onepage&q=active%20rfid%20tags%20first%20introduced%20commercially&f=false> accessed 2nd April 2015

⁸ IDTechEx. 2011. Active RFID and Sensor Networks 2011-2021. <http://www.idtechex.com/research/reports/active-rfid-and-sensor-networks-2011-2021-000255.asp> accessed on 9th April 2015

⁹ Research MOZ. 2015. RFID Forecasts, Players and Opportunities 2014-2024. <http://www.researchmoz.us/rfid-forecasts-players-and-opportunities-2014-2024-report.html#src=whatech> accessed 9th April 2015

¹⁰ RFID Journal. 2017. How often does an RFID tag need to be refreshed or replaced?

<https://www.rfidjournal.com/blogs/experts/entry?11948> Accessed 13th May 2019

¹¹ SBD. 2012. 2025 Every Car Connected: Forecasting the Growth and Opportunity. <http://www.gsma.com/connectedliving/wp-content/uploads/2012/03/gsma2025everycarconnected.pdf> accessed 10th April 2015

¹² Automotive News. 2014. Demand skyrockets for collision-avoidance sensors.

<http://www.autonews.com/article/20141013/OEM06/310139961/demand-skyrockets-for-collision-avoidance-sensors> accessed 2nd April 2015

¹³ Automotive Vehicle-to-Everything (V2X) Communications Market <http://www.slideshare.net/Visiongain/automotive-vehicle-toeverything-v2-x-communications-market-20142024>

Source	Summary of findings
2018 ¹⁴	Global collision avoidance sensors market size is expected to be \$18.97 billion by 2025 with a 21.2% CAGR during the forecast period. Europe is likely to retain its market leader position in the adoption of collision avoidance sensors and systems and reach \$5.8 billion by 2025.
2018 ¹⁵	In 2016, radar-based systems accounted for over 41% of the global market. The fall in the price of radars have led to the increased adoption of the technology by various automotive OEMs.

In the workshop undertaken for the previous study participants undertook an exercise to estimate the maximum market size of automotive vehicles with dedicated short-range communication and other assistive systems. Desk research estimated that the maximum market size would be 220 million. Workshop participants were slightly less optimistic suggesting that the maximum potential market size by 2030 would be 197m.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	3.0m	11.8m	45.2m	132m
Max market size by 2040	197m		Date brought to market	2012

Table 1.3: Electronic fee collection devices

LE Spectrum 5.795 - 5.805 GHz

Source	Summary of findings
2009 ¹⁶	Existing motorway Electronic Fee Collection (EFC) systems use DSRC between fixed roadside equipment and vehicles. Another EFC system is based on Global Navigation Satellite System (GNSS) and mobile telephone technology (GSM).
2010 ¹⁷	Japan is a leader in electronic toll collection (ETC) with 25 million vehicles (approx. 68% of all vehicles) equipped with ETC on-board units.
2014 ¹⁸	In Norway, from the 1 st of January 2015 it is mandatory for all vehicles weighing over 3.5 tonnes to have a signed contract with a toll road operator and a correctly installed, valid toll tag inside their windscreen.
2014 ¹⁹	There are approximately 27,346 ETC lanes in operation with net toll revenues of €26,313,650 in 21 countries.
2014 ²⁰	The global electronic toll collection market is estimated to reach \$9.5 billion by 2020 at a CAGR of 11.1% from 2014 to 2020.
2018 ²¹	The electronic toll collection market is expected to increase from \$7.1 billion in 2018 to \$10.7 billion in 2023, at a CARG of 8.54%

¹⁴ PR Newswire. 2018. Global Collision Avoidance Sensors Market Report 2018: Market size is expected to reach \$18.97 billion by 2025. <https://www.prnewswire.com/news-releases/global-collision-avoidance-sensors-market-report-2018-market-size-is-expected-to-reach-usd-18-97-billion-by-2025--300744605.html> Accessed 13th May 2019.

¹⁵ Business Wire. 2018. Global Automotive Collision Avoidance Systems Market 2018-2023: Radar based systems occupy highest market share. <https://www.businesswire.com/news/home/20180903005157/en/Global-Automotive-Collision-Avoidance-Systems-Market-2018-2023> Accessed 13th May 2019.

¹⁶ European Commission DG Energy and Transport. 2009. Intelligent Transport Systems. http://www.transport-research.info/Upload/Documents/201002/20100215_125401_19359_TRS_IntelligentTransportSystems.pdf accessed 2nd April 2015

¹⁷ ITIF. 2010. Intelligent Transportation Systems. http://www.itif.org/files/2010-1-27-ITS_Leadership.pdf accessed 8th April 2015

¹⁸ AutoPASS. 2014. Compulsory toll tag in Norway. <http://www.autopass.no/en/compulsory-tag/about-compulsory-tag?lang=en> accessed 2nd April 2015

¹⁹ ASECAP. 2014. Statistical Bulletin 2014. <http://www.asecap.com/english/documents/ASECAPStatisticalBulletin2014.pdf> accessed 2nd April 2015

²⁰ Markets and Markets. 2014. Electronic Toll Collection System Market by Products. <http://www.marketsandmarkets.com/Market-Reports/electronic-toll-collection-system-market-224492059.html> accessed 2nd April 2015

²¹ Markets and Markets. 2018. Electronic Toll Collection Market worth \$10.7 billion by 2023. <https://www.marketsandmarkets.com/PressReleases/electronic-toll-collection-system.asp> Accessed 13th May 2019.

Source	Summary of findings
2018 ²²	By 2025, there will be a rise in demand for effective traffic management at toll collection centre, increase in cashless travelling, reduced environmental pollution, a rise in adoption of ETC systems in developing regions, and more stringent government regulations regarding toll collection.

An ASECAP study examined 15 EU28 Member States. These countries had 27,016 electronic toll points (ETC lanes). If utilisation per capita in these countries was extrapolated across EU28 Member States, there would be 31,290 electronic toll points. Participants at the workshop highlighted that a problem has arisen because in Europe and Japan the DSRC frequencies have been used in electronic toll collection. At some point this problem will need to be addressed.

As a result we have provided a static estimate for electronic toll points.

		2015	2020	2025	2030
Estimated devices in EU28 Member States		31,290	31,290	31,290	31,290
Max market size by 2030	31,290	Date brought to market		1986	

1.3 Application category 3: Smart home devices (alarms, telecommand and telemetry devices)

These devices are generally associated with many different ways in which ‘smart homes’ can be developed. Devices in the alarms, telecommand and telemetry category span a wide range of different types. For this reason, they are grouped together in this overview.

Table 1.4: Alarm devices

Source	Summary of findings
2010 ²³	Forecast for between 30 and 39 million wireless alarms project for 2015 in Europe
2013 ²⁴	Number of wireless M2M modules for monitored tracking devices and wireless alarm systems forecasted to reach 29 million units by 2018
2014 ²⁵	Estimation of 3.3 million smart home systems in Europe at the end of 2014
2018 ²⁶	The global wireless alarm market is expected to grow at an 11% CARG between 2017 and 2023. This will lead to a total of \$140 billion by 2023

²² Allied Market Research. 2018. Electronic toll collection market subsystem, technology, and application – global opportunity analysis and industry forecast, 2018-2025. <https://www.alliedmarketresearch.com/electronic-toll-collection-system-market> Accessed 13th May 2019

²³ Ofcom, 2010. Short Range Devices operating in the 863 – 870 MHz frequency band. http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/Final_report.pdf

²⁴ Statista. 2013. Shipments of wireless M2M monitored tracking devices/wireless alarm systems EU27+2 from 2013 to 2018 (in millions). <http://www.statista.com/statistics/295872/m2m-tracking-devices-wireless-alarm-systems-eu27-2/> Accessed 31st March 2015

²⁵ Fagerberg, J. 2014. The number of smart homes in Europe and North America reached 10.6 million in 2014. Telecoms Daily. <http://telconewsletters.com/telco-newsletters/the-number-of-smart-homes-in-europe-and-north-america-reached-10-6-million-in-2014/> Accessed 31st March 2015

²⁶ Security World Market. 2018. Global wireless alarm market to experience healthy growth. <https://www.securityworldmarket.com/na/News/Business-News/global-wireless-alarm-market-to-experience-healthy-growth1#.XNI-z9NKiWY> Accessed 13th May 2019

There are many types of wireless alarms that can be used in the home - intruder alarms, smoke detectors, water/flood detectors, PIR sensors for inactivity or security, carbon monoxide detectors. Social alarms and distress alarms are considered separately.

Table 1.5: Key fobs

Source	Summary of findings
2013 ²⁷	35 million vehicles licensed for use on the road in Great Britain
2013 ²⁸	1 billion cars and trucks on the road worldwide, 2030 this is thought to reach 1.7 billion. This equates to approximately 220 million in EU28 Member States
2014 ²⁹	By 2015 the number of vehicles in Europe expected to increase to 400 million, with 60% of these vehicles equipped with one or more SRDs. 80% of all new vehicles currently equipped with SRD devices
2014 ³⁰	Estimation of 3.3 million smart home systems in Europe at the end of 2014
2018 ³¹	The global automotive smart key fob market is expected to grow at an CAGR of nearly 4% between 2018 and 2022

Table 1.6: Baby monitors

Source	Summary of findings
No date ³²	For UK only there are over 400,000 Baby Monitors sold each year
2017 ³³	The global baby monitor market size is predicted to reach \$1.63 billion by 2025. In 2016, the largest market was in North America, accounting for 47.9% of revenue shares.
2018 ³⁴	Global baby monitors market revenue is expected to grow at a CAGR of 4.4% from 2016 to 2024.
2019 ³⁵	The Smart baby monitors market is expected to grow at a CAGR of over 20% from 2019 to 2023
2019 ³⁶	The global baby monitors market is projected to grow at a rate of 8.7% during 2018 and 2023

²⁷ Jeremy Grove. 2013. Vehicle Licensing Statistics

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/302409/vls-2013.pdf accessed 31st March 2015

²⁸ The International Council on Clean Transportation. 2013. European vehicle market statistics

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/302409/vls-2013.pdf accessed 31st March 2015

²⁹ ECC Report 189. 2014 <http://www.ero-docdb.dk/Docs/doc98/official/pdf/ECCREP189.PDF> 31st March 2015

³⁰ Fagerberg, J. 2014. The number of smart homes in Europe and North America reached 10.6 million in 2014. Telecoms Daily.

<http://telconewsletters.com/telco-newsletters/the-number-of-smart-homes-in-europe-and-north-america-reached-10-6-million-in-2014/> Accessed 31st March 2015

³¹ Business Wire. 2018. Global automotive smart key fob market 2018-2022.

<https://www.businesswire.com/news/home/20181119005238/en/Global-Automotive-Smart-Key-Fob-Market-2018-2022> Accessed 13th May 2019

³² Medic8. No date. Baby Monitors. <http://www.medic8.com/healthguide/pregnancy-birth/mother-baby/caring-baby/baby-monitors.html> Accessed 31st March 2015

³³ Markets Insider. 2017. The global baby monitors market size to reach \$1.63 billion by 2025.

<https://markets.businessinsider.com/news/stocks/the-global-baby-monitors-market-size-to-reach-usd-1-63-billion-by-2025-1008335538> Accessed 13th May 2019

³⁴ Transparency Market Research. 2018. Increasing expenditure on child care to bode well for global baby monitors market; exhibit steady 4.4% CAGR. <https://www.transparencymarketresearch.com/pressrelease/baby-monitors-market.htm> Accessed 13th May 2019.

³⁵ Business Wire. 2019. Global Baby Monitors Market 2019-2023.

<https://www.businesswire.com/news/home/20190111005262/en/Global-Baby-Monitors-Market-2019-2023-Technology-Innovation> Accessed 13th May 2019

³⁶ Mordor Intelligence. 2019. Baby monitors market – segmented by product type, mode of communication distribution channel and geography – growth, trends and forecasts (2019-2024). <https://www.mordorintelligence.com/industry-reports/baby-monitors-market> Accessed 13th May 2019

Statistics with regards to Baby monitors are very difficult to obtain, however it is believed that 400,000 are sold each year in the UK. This equates to approximately 2.35 million in EU28 Member States.

Table 1.7: Garage door/gate openers

LE Spectrum 433 – 434.79 MHz, 863 – 865 MHz, 5.72 – 5.87 GHz

Source	Summary of findings
2006 ³⁷	53% of households in UK had access to a garage in 2006 and only 24% of people used them
2010 ³⁸	9.3 million private garages in the UK, almost half of privately owned homes have one
2015 ³⁹	213,839.2 households (thousands) in total in EU28 in 2013
2015 ⁴⁰	Estimation of 3.3 million smart home systems in Europe at the end of 2014

1.4 Application category 4: Audio media wireless streaming devices

There has been intensive growth in the audio media wireless streaming segment in recent years because of enhancements in wireless technology, audio signal processing and miniaturisation of electronics. The key aspect is the wireless connectivity that provides the convenience and flexibility of the user to operate and use the devices remotely. The connectivity technology varies between FM, Bluetooth, Klear (which is a proprietary technology) and Wi-Fi. Bluetooth has become a significant part of the wireless audio ecosystem with Bluetooth speakers experiencing particularly rapid growth.⁴¹

Table 1.8: Wireless headphones

LE Spectrum 863 – 865 MHz

Source	Summary of findings
2011 ⁴²	Market leader Beats Electronics expected to gain \$350 million in revenue.
2014 ⁴³	Global market expands with trends towards added functionality such as Bluetooth capability. Estimated 286 million units shipped.
2015 ⁴⁴	Analysts forecast the global headphone market to grow at a CAGR of 12.7 per cent in terms of revenue over the period 2015-2019. It is also predicted that the volume will grow at a CAGR of 4.1 per cent
2019 ⁴⁵	Global earphone market is expected to reach \$36 billion by 2024 growth at CAGR of around 13% between 2018 and 2024

³⁷ BBC News, 2006. MPs 'astonished' at empty garages. <http://news.bbc.co.uk/1/hi/5105090.stm> Accessed 31st March 2014

³⁸ Wallop, H. 2010. Death of garages as home owners convert space to offices. <http://www.telegraph.co.uk/finance/property/house-prices/7718889/Death-of-garages-as-home-owners-convert-space-to-offices.html> Accessed 31st March 2015

³⁹ Eurostat. 2015. Households with broadband access. http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_pibi_hba&lang=en Accessed 31st March 2015

⁴⁰ Fagerberg, J. 2014. The number of smart homes in Europe and North America reached 10.6 million in 2014. Telecoms Daily. <http://telconewsletters.com/telco-newsletters/the-number-of-smart-homes-in-europe-and-north-america-reached-10-6-million-in-2014/> Accessed 31st March 2015

⁴¹ Consumer Electronics Industry Revenues to Reach All-Time High in 2014, Projects CEA's Semi-Annual Sales and Forecasts Report, July 2014 <https://www.ce.org/News/News-Releases/Press-Releases/2014/Consumer-Electronics-Industry-Revenues-to-Reach-All.aspx>

⁴² Major Beats: Beats Electronics may be on track to hit \$1.4b in 2013 revenue. <http://www.fastcompany.com/3015051/major-beats-beats-electronics-may-be-on-track-to-hit-14b-in-2013-revenue>. Accessed 15th April 2015.

⁴³ Headphones market booming, volume and value on the up. <http://www.futuresource-consulting.com/2014-09-headphones-market-press-release-3286.html>. Accessed 15th April 2015.

⁴⁴ Sandler Research. 2015. Global Headphone Market 2015-2019. Accessed 2nd April 2015 <http://www.sandlerresearch.org/global-headphone-market-2015-2019.html>.

⁴⁵ Research and Markets Globe Newswire. 2019. Global earphone and headphones market report 2019-2024: major players are Apple, Bose, Samsung, Sony, Sennheiser and Skullcandy. <https://uk.finance.yahoo.com/news/global-earphones-headphones-market-report-160000425.html> Accessed 15th May 2019

Table 1.9: Media players

LE Spectrum 863 – 865 MHz

Source	Summary of findings
2013	Apple announced that they had sold 100 million iPod touch devices since its launch in 2007. ⁴⁶
2014	Apple sold 6 million iPod results during the holiday quarter of 2014, a decrease of 55 per cent for revenue and 52 per cent on units compared to the 12.7 million units it sold in Q1 in 2013.
2015 ⁴⁷	By Q1 2017, 40 per cent of U.S. Internet homes will have a streaming media player, bringing the total number of homes with these devices to 39 million

NPD research stated in January 2015 that streaming media player penetration in US households stood at 16 per cent in 2014. This was expected to increase to 25 per cent in 2015, 33 per cent in 2016 and 40 per cent in 2017.⁴⁸ This rate would equate to the very highest s-shaped adoption curve adopted for devices identified in our previous research.

Past and future adoption data aligns forecasts with ‘fast’ s-shaped adoption curve. This predicts growth from 55 million (22 per cent of maximum market size) in 2015, reaching 196 million (78 per cent of maximum market size) in 2020. The ‘fast-low’ s-shaped curve predicts 99 per cent penetration of maximum market size in 2026.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	55m	196m	243m	250m
Max market size by 2030	252m		Date brought to market	Unknown

Table 1.10: Wireless Speakers

LE Spectrum 863 – 865 MHz

Source	Summary of findings
2013 ⁴⁹	In the first quarter of 2013, sales of portable AC/DC and AC-only Bluetooth speakers surged 432 per cent in units to 744,000 and by 242 per cent in dollars to \$80.6 million.
2014 ⁵⁰	Global Bluetooth speaker market to be worth \$7 billion by 2019.
2014 ⁵¹	28 per cent of American consumers indicated plans to buy portable wireless speakers or similar before 2016.
2018 ⁵²	The global wireless speakers market is expected to reach \$27 billion by 2023, growing at a CAGR

⁴⁶ Apple announces 100m iPod Touches sold since inception in 2007. <http://9to5mac.com/2013/05/30/apple-announces-100m-ipod-touches-shipped-since-inception-in-2007/>. Accessed 15th April 2015.

⁴⁷ NPD.2015. Streaming Media Player Penetration to Reach 40 per cent of U.S. Internet Homes by 2017, According to NPD. <https://www.npd.com/wps/portal/npd/us/news/press-releases/2015/streaming-media-player-penetration-to-reach-40-percent-of-us-internet-homes-by-2017/>. Accessed 2nd April 2015.

⁴⁸ Streaming media player penetration to reach 40 per cent of US internet homes by 2017 according to NPD. <https://www.npd.com/wps/portal/npd/us/news/press-releases/2015/streaming-media-player-penetration-to-reach-40-percent-of-us-internet-homes-by-2017/>. Accessed 15th April 2015.

⁴⁹ No blues for Bluetooth speaker market. <http://www.twice.com/news/news/no-blues-bluetooth-speaker-market/42489>. Accessed 15th April 2015.

⁵⁰ Bluetooth speakers market worth \$7 billion by 2019. <http://www.prnewswire.com/news-releases/bluetooth-speakers-market-worth-7-billion-by-2019-283587821.html>. Accessed 15th April 2015.

⁵¹ CEA reports continued growth in wireless, multi-room audio system sales. <http://www.ce.org/News/News-Releases/Press-Releases/2014/CEA-Reports-Continued-Growth-in-Wireless,-Multi-Ro.aspx> Accessed 15th April 2015.

Source	Summary of findings
	of around 17% between 2018 and 2023

In the first quarter of 2013, sales of US portable AC/DC and AC-only Bluetooth speakers surged 432 per cent in units to 744,000 and by 242 per cent in dollars to \$80.6 million. This surge in popularity is linked to the increase in popularity of smartphones, and the use of these phones to store music. This level of US sales would represent global sales of approximately 1.4 billion and 12.9 million devices. This would equate to approximately 2.5 million devices in EU28 in 2014.

The Global Bluetooth Speaker market is set to grow at a CAGR of 38.7 per cent during 2014-2019 and it is estimated it will be worth \$7 billion globally by 2019.

At the EC workshop past and future adoption data was thought to aligns forecasts with the 'slow-high' s-shaped adoption curve. This predicts growth from 5.2 million (4 per cent of maximum market size) in 2015, reaching 36 million (24 per cent of maximum market size) in 2020.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	5.2m	36.0m	104.0m	150.0m
Max market size by 2030	150m	Date brought to market		Unknown

Table 1.11: Wireless microphones

LE Spectrum 863 – 865 MHz

Source	Summary of findings
2011 ⁵³	In 2011 total wireless microphone turnover in the EU was estimated at approximately €170m and 260,000 units/systems.
2010 ⁵⁴	In a paper about devices operating in the 863-870 MHz frequency a forecast was made about the number of wireless microphones in the UK. There was a conservative and an aggressive prediction resulting in estimates of between 175,000 and 263,000 units. This equates to approximately 1.4m devices in EU28.
2011 ⁵⁵	In 2011 wireless microphones were Sennheiser's second biggest share of the company's turnover, at 26.4 per cent of the total.
2013 ⁵⁶	In 2013, it was estimated that there were 2 million wireless microphones in EU Member States.
2019 ⁵⁷	The global wireless microphone market is expected to reach \$3.63 billion by 2023, with 8.44% CAGR from 2017 to 2023.

The 2010 Ofcom estimated the number of wireless microphones in the UK equates to approximately 1.4m devices in EU28. Growth at 260,000 devices per annum equates well with the 2013 estimate of 2 million wireless microphones in EU Member States. In comparison with other devices this is relatively slow growth rate.

⁵² Research and Markets. 2018. Wireless Speaker Market – Global Outlook and Forecast 2018-2023.

<https://www.researchandmarkets.com/reports/4587500/wireless-speaker-market-global-outlook-and> Accessed 15th May 2019.

⁵³ Assessment of socio-economic aspects of spectrum harmonisation regarding wireless microphones and cordless video cameras (PMSE equipment). European Commission DG Communications networks, p5

⁵⁴ Ofcom. 2010. Short range devices operating in the 863 – 870 MHz frequency band. page14. http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/Final_report.pdf (2015 value is a projection). Accessed 2nd April 2015.

⁵⁵ Successful company restructure: Sennheiser enjoys strong turnover and profit growth in 2011. <http://en-uk.sennheiser.com/news-successful-company-restructure-sennheiser-enjoys-strong-turnover-and-profit-growth-in-2011-> Accessed 15th April 2015.

⁵⁶ Assessment of socio-economic aspects of spectrum harmonisation regarding wireless microphones and cordless video cameras (PMSE equipment). European Commission DG Communications networks, p.4

⁵⁷ Market Research Future. 2019. Wireless Microphone Market Research Report – Global forecast to 2023. <https://www.marketresearchfuture.com/reports/wireless-microphone-market-4590> Accessed 15th May 2019

At the workshop it was agreed that past and future adoption data aligns with the 'slow' s-shaped adoption curve for devices. This predicts growth from 2 million (3 per cent of maximum market size) in 2015, reaching 12.5 million (18 per cent of maximum market size) in 2020.

An overview of this device and adoption forecasts is provided below, updated to reflect more recent developments:

		2015	2020	2025	2030
Estimated devices in EU28 Member States		1.5m	12.5m	41m	68m
Max market size by 2030	69m	Date brought to market			2000

Table 1.12: Audio media wireless streaming devices overview

		2015	2020	2025	2030
Estimated audio media wireless streaming devices in EU28 Member States		75.8m	282.5m	435m	516m
Max market size by 2030	520m	Earliest date to market			1990

1.5 Application category 5: Remote monitoring and wireless alarm devices

This category primarily concerns remote monitoring of equipment (e.g. utility meters) and wireless alarms (e.g. social and distress alarms). The key applications in the remote monitoring category is smart metering which we consider as part of the wireless M2M market. Many of these types of applications are currently addressed by a combination of cellular-based systems and, mainly proprietary, Low Power Wide Area (LPWA) systems. This section addresses specific alarm type applications for home distress and social use.

Table 1.13: Utility meters

Source	Summary of findings
2010 ⁵⁸	1,700 shipments (thousands) of smart water meters for 2015.
2011 ⁵⁹	Market revenue for smart water meters in Europe was \$1.2bn in 2010, with this projected to become \$7.8bn in 2020, and \$2.6bn in 2015. Approximately 40 million smart water meters were installed in 2015, 100 million projected 2020 and 180 million in 2030.
2012 ⁶⁰	The global smart water meter market to grow at a CAGR of 15 per cent in 2011–2015.
2013 ⁶¹	A source mentions the smart water management market is expected to grow from \$5.43 billion to \$12.03 billion between 2013 and 2018, at an estimated CAGR of 17.2 per cent.
2014 ⁶²	Approximately 157 million water meters installed in Europe with an indication that 31% of all

⁵⁸ Pike Research. Published 3Q 2010. Smart Water Meters – Advanced Metering Infrastructure for Water Utilities: Market Drivers, Technology Issues, Deployment Case Studies, Key Industry Players, and Market Forecasts. <http://www.navigantresearch.com/wordpress/wp-content/uploads/2010/07/SWAT-10-Executive-Summary.pdf> accessed 31st March 2015

⁵⁹ Frost and Sullivan. 2011. Utilities Push the European Smart Water Metering Market. <http://www.slideshare.net/FrostandSullivan/european-smart-water-metering-market-9153856> accessed 31st March 2015

⁶⁰ The global smart water meter market to grow at a CAGR of 15 per cent in 2011–2015.

⁶¹ Markets and Markets. 2013. Smart Water Management Market worth \$12.03 billion by 2018. <http://www.marketsandmarkets.com/PressReleases/smart-water-management.asp> accessed 15th April 2015

Source	Summary of findings
	new water meters will be smart or smart enabled by 2016
2018 ⁶³	In 2019 there were 14.9 million smart meters operating in homes and small businesses in Great Britain. This well below the target of 52 million. These figures would equate to approximately 89 million installed in EU28 Member States respectively.

Journalistic sources suggest that smart water meters are continuously being integrated in Europe. It was reported that the global smart water meter market was to grow at a CAGR of 15% between 2011 and 2015, whilst another source reports that smart water management markets to grow at a CAGR of 17.2% from 2013 to 2018.

The ECC report (published 2011) suggests that in 2015 there would be approximately 40 million smart water meters installed, with 100 million projected in 2020 and 180 million in 2030.

In 2018 it was claimed there are 89m smart meters operating, therefore we estimate that in 2020 there will be 128m. Forecasts shared and validated at the EC workshop suggest there will be 180m smart meters in 2025 and 231m in 2030.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	54.1m	128m	180m	231m
Max market size by 2030	235m			Date brought to market
				1990

Table 1.14: Social alarms

LE Spectrum 868.6 – 869 MHz

Source	Summary of findings
2014 ⁶⁴	2.6 million units in ordinary housing in Europe

Social alarms are used to summon help and assistance in a household or to support housing environments. Carers, housing wardens or other home care organisations respond to calls.

The Swedish study estimated 2.6 million social alarm units in EU28 Member States in 2015. This would equate to an alarm in 1.2 per cent of EU28 households. Social alarm services are provided across the whole country and are provided to both older people in supported housing and ordinary housing. The main drivers and providers of social alarms in the Netherlands have been the municipalities and their organisations for well-being and welfare as well as the home care organisations. Take-up of social alarm services in the Netherlands is estimated at 3% of the population aged over 65.⁶⁵

Social alarms have been available for many years, it is therefore suggested that uptake has been very slow. An increasingly elderly population may increase demand. The proportion of people over 65 is expected to increase from 15.7 per cent in 2000 to 30 per cent in 2050. This almost represents a doubling in numbers.

⁶² ECC Report 189. 2014. Future Spectrum Demand for Short Range Devices in the UHF Frequency Bands. <http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP189.PDF> accessed 31st March 2015

⁶³ Department for Business, Energy and Industrial Strategy. 2018. Smart Metering Implementation Programme. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/827813/2019_Q2_Smart_Meters_Statistics_Report.pdf Accessed 15th May 2019.

⁶⁴ The Swedish Agency for Participation. May 13th 2014. Nationwide Deployment of Social Alarms in Sweden. eHealth forum Athens Greece. http://ehealth2014.org/wp-content/uploads/2014/06/Pres_Leidegren_J.pdf accessed 31st March 2015

⁶⁵ http://www.ict-ageing.eu/?page_id=356

Past and future adoption data aligns forecasts with the 'slow' s-shaped adoption curve. This predicts growth from 2.6 million (3.6 per cent of maximum market size) in 2015, reaching 12 million (17 per cent of maximum market size) in 2020.

		2015	2020	2025	2030
Estimated devices in EU28 Member States		2.6m	12m	39m	72m
Max market size by 2030	72m	Date brought to market			unknown

Table 1.15: Distress alarms

LE Spectrum 868.6 – 869 MHz

Source	Summary of findings
2014 ⁶⁶	Likely to reach 3 million in Europe by 2020
2014 ⁶⁷	An increasing number of elderly people is likely to increase growth. Prediction of CAGR of 6.4 per cent between 2014 and 2020.

Very little market information is available about distress alarms, also called personal emergency response systems (PERS) and panic alarms.

An OC study seems to suggest a very low estimate for the number of alarms in Europe – 3 million by 2020. Eurostat estimate there are 55 million elderly people in Europe. We make the assumption that perhaps five per cent of the elderly population might have distress alarms at present. No evidence to provide an insight to a figure could be found, hence the assumption is arbitrary, but was thought to be reasonable at the EC workshop. This would equate to 2.75 million people. This might be an over estimate, but it would also accommodate single women and less able people that might also have these alarms.

Past and future adoption data aligns forecasts with the 'slow-low' s-shaped adoption curve. This predicts growth from 7.5 million (8 per cent of maximum market size) in 2015, reaching 24 million (28 per cent of maximum market size) in 2020.

		2015	2020	2025	2030
Estimated devices in EU28 Member States		7.5m	24m	56m	84m
Max market size by 2030	84m	Date brought to market			unknown

Table 1.16: Remote monitoring and wireless alarm devices overview

		2015	2020	2025	2030
Estimated remote monitoring and wireless alarm devices in EU28 Member States		64.2m	164m	275m	387m
Max market size by 2030	391m	Earliest date to market			1990

⁶⁶ OC Consulting. 2014. <https://www.linkedin.com/groups/Global-Medical-Alert-Systems-Market-3953406.S.5912211393691541507>

⁶⁷ Industry Arc. 2014. Global Medical Alert Systems Market (2014-2020)

1.6 Application category 6: Wideband data transmission devices

This category primarily concerns devices that use licence-exempt spectrum for wideband data transmissions. This covers a range of devices for relatively short-range local area or personal area wireless networks facilitated through a routers usually provided by broadband providers. These support high data rate applications such as audio and video streaming, real time gaming, Internet browsing, file transfers and email.

Wideband data transmissions using licence-exempt spectrum typically use Wi-Fi for local area networks applications, such as providing wireless connectivity across a home, or Bluetooth for smaller personal area networks, such as removing the need for a cable between a headset and smartphone. These technologies use the 2.4 GHz and 5 GHz Industrial, Scientific and Medical (ISM) bands.

Table 1.17: Tablets

LE Spectrum 2.4 – 2.48, 5.15 -5.35, 5.47 – 5.725 GHz

Source	Summary of findings
2013 ⁶⁸	Research conducted by Gartner found that global total tablet sales in 2013 to amount to 195,435,004 units
2017 ⁶⁹	Annual unit shipments of tablets were forecast to be 208 million in 2015. This equates to 27.2 million in EU28 Member States.
2018 ⁷⁰	Over 900 million tablets will be in use globally by 2022. This equates to 117 million in EU28 Member States.

Rethink Research has obtained data from vendors about the volume of tablets utilised in EU28 Member States. This vendor data suggests that the number of tablets in use in EU28 Member States in 2010 was 4.69 million and this number was expected to steadily increase.

The vendor estimated market size in EU28 Member States in 2015 was 120 million. These forecasts were shared with workshop participants in the vendor and expert workshop on 17th March 2015. None of the participants questioned these forecasts.

Desk research found that 2017 and 2018 forecasts were lower than previous expectations and sales were expected to slowly decrease. This sales decline (lagged) contributes to the long-term forecast decline in the total number of devices in use in EU28 Member States up to 2030.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	120m	131m	128m	120m
Max market size	131m		Date brought to market	2002

⁶⁸ Gartner.2014. Market Share: Ultramobiles by Region, OS and Form Factor, 4Q13 and 2013.

<http://www.gartner.com/newsroom/id/2674215>.

⁶⁹ Statista. 2017. Forecast unit shipments of tablets worldwide from 2010 to 2023(in million units).

<https://www.statista.com/statistics/269912/worldwide-tablet-shipments-forecast/> Accessed 15th May 2019.

⁷⁰ Knowledge Centre. 2018. Tablets: worldwide market trends, forecasts and operator strategies 2012-2022.

<http://www.analysismason.com/Research/Content/Regional-forecasts-/tablet-worldwide-forecast-RDMD0/> Accessed 15th May 2019.

Table 1.18: Smartphones**LE Spectrum 2.4 – 2.48, 5.15 -5.35, 5.47 – 5.725 GHz**

Source	Summary of findings
2009 ⁷¹	The most recent Eurostat data (2009) showed that there were 125 subscriptions to cellular mobile services per 100 people.
2014 ⁷²	According to research by eMarketer, at the end of 2015 there will be 1.91 million smartphone users worldwide.
2015 ⁷³	Sales tracking performed by GfK shows that 197.8 million smartphones were sold in Europe last year (2014).
2015	Rethink research has provided a forecast for the end of 2015 and the years following up to 2020 on the number of smartphones in use. They estimate 566m in 2015.
2018 ⁷⁴	Global volume of smart phones will reach 1.9 billion units in 2022, with a CAGR of 4.1% between 2017 and 2022. This equates to approximately 400 million units in EU28 Member States.

Rethink Research has obtained data from vendors about the volume of smartphones utilised in EU28 Member States. This vendor data suggests that the number of smartphones in use in EU28 Member States in 2010 was 151 million. This number is expected to steadily increase.

Vendor data estimates suggests that the number of smartphones in use in EU28 Member States in 2015 will be 566 million. This number is expected to steadily increase.

Workshop participants undertook an exercise to estimate the maximum market size for the smartphone market by 2030. This estimated that the maximum market size would be 825 million in EU28 Member States. The CAGR of 4.1% between 2017 and 2022 causes the value in 2020 to be 736 million. After this period, the CAGR slows down to 0.42. There will therefore be 824 million smartphones by 2030.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	566m	736m	807m	824m
Max market size by 2030	825m			Date brought to market
				2000

Table 1.19: Games consoles**LE Spectrum 2.4 – 2.48, 5.15 -5.35, 5.47 – 5.725 GHz**

Source	Summary of findings
2015 ⁷⁵	VGCharts keeps track of the number of games console that have been sold, the total number of consoles globally (with wireless capabilities) is 212.3 million in 2015.
2018 ⁷⁶	The global retail value of the games console business is predicted to reach \$15.4 billion, increasing by 7.6%. 2019 revenues are expected to fall by 10% and 2023 revenues will return to 2018 levels

⁷¹ Data taken from Eurostat isoc_tc_ac2

⁷² eMarketer. 2015. <http://www.emarketer.com/Article/2-Billion-Consumers-Worldwide-Smartphones-by-2016/1011694>. Accessed April 8th 2015

⁷³ GfK. 2015. Global smartphone sales exceed 1.2B units in 2014. <http://www.gfk.com/news-and-events/press-room/press-releases/pages/global-smartphone-sales-exceed-1-2b-units-in-2014>. Accessed March 10th

⁷⁴ Research and Markets. 2018. Worldwide smartphone market forecast, 2018-2022.

<https://www.researchandmarkets.com/reports/4471265/worldwide-smartphone-market-forecast-2018-2022> Accessed 15th May 2019.

⁷⁵ VGCharts. 2015. Platform totals. http://www.vgchartz.com/analysis/platform_totals. Accessed March 15th

⁷⁶ Business Wire. 2018. Nintendo will take number one spot from Sony in 2019 game console market, says strategy analytics.

<https://www.businesswire.com/news/home/20181129005477/en/Nintendo-Number-Spot-Sony-2019-Game-Console> Accessed 15th May 2019.

The VGCharts forecast was calculated by finding the total of all consoles that have wireless capabilities: Nintendo DS, Wii, PS3, Xbox 360, PSP, Nintendo 3DS, PS4, Xbox One, PS Vita and the WiiU. This produced a total of 212.3 million devices used globally in 2015. This would equate to 27 million devices in EU28.

There is limited data available for game console sales as the games console market is very lucrative and larger companies will very rarely share market data as this can provide an advantage to their competitors.

EC workshop participants undertook an exercise to estimate the maximum market size for the games console market by 2030. They estimated that the maximum market size would be 77 million.

		2015	2020	2025	2030
Estimated devices in EU28 Member States		27m	39m	56m	77m
Max market size by 2030	77m	Date brought to market			2004

Table 1.20: Smart Televisions

LE Spectrum 2.4 – 2.48, 5.15 -5.35, 5.47 – 5.725 GHz

Source	Summary of findings
2010 ⁷⁷	Statista has created a forecast that predicts the number of connected TV sets worldwide will be 486.7 million in 2020.
2012 ⁷⁸	A study by Ovum has predicted the number of smart TV sets in homes in 2017 to be 836 million.
2013 ⁷⁹	Informitv predict that the 346 million global Smart TVs will account for a third of connected television sets by 2020, up from 115 million in 2014.
2014 ⁸⁰	Digital TV research has forecast the number of smart TVs to reach 965 million in 2020.
2015 ⁸¹	Cisco estimate that smart TVs will account for 13 per cent (2.6 billion) of all networked devices in 2018, compared to 10 per cent (1.2 billion) in 2013
2018 ⁸²	The global smart TV market is expected to grow at a CAGR of over 16.5% from 2018 to 2023.
2019 ⁸³	By 2024 it is forecasted that 81% of total TV sales will be Smart TVs

Eurostat data highlights that more than 95 per cent of households have a TV. 231m households would constitute a 85 per cent household adoption level in 2030. This level is therefore thought to be the maximum market size in EU28.

Cisco forecasts equate to 15m Smart TVs in Europe in 2014 and 45 million in 2020.

An overview of this device and adoption forecasts were shared at the EC Workshop. None of the participants questioned the predictions. From 2018 to 2023 the market is forecast to increase at a

⁷⁷ Statista. 2010. <http://www.statista.com/statistics/247160/forecast-of-the-number-of-connected-tv-sets-worldwide>. Accessed March 10th

⁷⁸ Ovum. 2012. <http://www.telecomsmarketresearch.com/research/TMAABKDC-Smart-TV-Device-Forecasts-2012-2017>. Accessed March 10th

⁷⁹ Informitv <https://informitv.com/2014/09/17/a-billion-internet-television-sets-by-2020/>

⁸⁰ Digital TV research. 2014. Connected TV forecasts. <https://www.digitaltvresearch.com/products/product?id=108>. Accessed March 10th

⁸¹ Cisco http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html

⁸² Mordor Intelligence. 2018. Smart TV market share, size – segmented by resolution type and region – growth, trends and forecasts (2019-2024). <https://www.mordorintelligence.com/industry-reports/smart-tv-market> Accessed 15th May 2019.

⁸³ Advanced television. 2019. Forecast: Smart TVs 81% of total TV sales in 2024. <https://advanced-television.com/2019/04/16/forecast-smart-tvs-81-of-total-tv-sales-in-2024/> Accessed 15th May 2019

CAGR of 16.5% causing the 2020 value to be 41.4m. After this point to 2025, the CAGR is forecast to be 25%. Finally, the 2030 value will reach 231million.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	17m	41.4m	137m	231m
Max market size by 2030	231m		Date brought to market	2012

Table 1.21: Wearable devices

LE Spectrum 2.4 – 2.48, 5.15 -5.35, 5.47 – 5.725 GHz

Source	Summary of findings
2013 ⁸⁴	Statista have released a forecast for the projected total global shipments (from 2013 to 2018), their 2015 forecast is 60.6 million units
2014 ⁸⁵	CSS Insight have recently conducted a wearable forecast and have predicted that in 2018 135 million wearable devices will be sold bringing the cumulative total sold since 2014 to 370 million. In the same article they also state that 22 million units of wearable tech were sold worldwide in 2014. Using a beta version of the tool, this amounts to 3.6m
2014 ⁸⁶	Deloitte predicted that smart glasses, fitness bands and watches, would sell about 10 million units in 2014
2014 ⁸⁷	Futuresource consulting estimated that global shipments would reach 52 million in 2014
2018 ⁸⁸	Global wearable device sales are expected to grow 26% in 2019 and total revenue from end-users will be \$42 billion

The table above demonstrates significant differences in forecasts between studies, ranging from 22 to 60.6 million units forecast in 2014 and 2015 respectively. And 10 million for the Deloitte study of the main wearable devices. The Statista study was therefore omitted from this study.

The estimated market size in EU28 Member States in 2015 was 8.5 million. These forecasts were shared with workshop participants in the vendor and expert EC workshop. None of participants questioned these forecasts.

EC Workshop participants undertook an exercise to estimate the maximum market size for wearable devices by 2030. They estimated that the maximum market size would be 567 million.

Past and future adoption data aligns forecasts with the 'medium' s-shaped adoption curve this is well aligned with Gartner forecast of approximately 26% growth.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	8.5m	102m	388m	567m
Max market size by 2030	567m		Date brought to market	2011

⁸⁴ Wearable technology worldwide projected total unit shipments from 2013 to 2018 (in millions). 2013. Statista. <http://www.statista.com/statistics/302500/wearable-technology-worldwide-unit-shipments/>. Accessed March 25th

⁸⁵ Smartwatches and Smart Bands dominate fast-growing wearables market. 2014. CCS insight. <http://www.ccsinsight.com/press/company-news/1944-smartwatches-and-smart-bands-dominate-fast-growing-wearables-market>. Accessed March 25th

⁸⁶ Deloitte. 2014. Technology, media and telecommunications predictions. <http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Technology-Media-Telecommunications/gx-tmt-predictions-2014.pdf>

⁸⁷ <http://www.wearable.com/wearable-tech/wearable-tech-sales-to-top-50-million-in-2014-445>

⁸⁸ Gartner. 2018. Gartner says worldwide wearable device sales to grow 26 percent in 2019. <https://www.gartner.com/en/newsroom/press-releases/2018-11-29-gartner-says-worldwide-wearable-device-sales-to-grow> Accessed 15th May 2019.

Table 1.22: Virtual reality head display**LE Spectrum 2.4 – 2.48, 5.15 – 5.35, 5.47 – 5.725 GHz**

Source	Summary of findings
2014 ⁸⁹	KZero 2015 forecast global sales of head mounted display units are expected to reach 39 million worldwide in 2018, whilst sales of accessories such as suits and gloves that interact with VR systems are expected to reach 10 million over the same time period
2015 ⁹⁰	Forecast sales for VR headsets and have estimated cumulative global sales from VR devices to total 56,800,000 from 2014 to 2018
2018 ⁹¹	VR headsets are expected to reach 26.7 million shipment units from 8.5 million in 2019.
2019 ⁹²	The VR market is expected to grow from \$7.9 billion to \$44.7 billion at a CAGR of 33.5%

The KZero 2015 forecast would equate to between 5 and 7.5 million head mounted display units in EU28 Member States in 2018.

An overview of adoption forecasts was shared at the EC Workshop and none questioned the forecasts.

Workshop participants undertook an exercise to estimate the maximum market size for virtual reality devices by 2030. The study estimated that the maximum market size would be 78 million.

8.5 million units in 2019 growing at a 33.5% CAGR causes an increase to 11m in 2020 and 48m in 2025. After this point, the market will growth at a 10.15% CAGR to reach 78m units in 2030.

	2015	2020	2025	2030
Estimated devices in EU28 Member States	1m	11m	48m	78m
Max market size by 2030	78m			Date brought to market
				2013

Table 1.23: Wideband data transmissions devices overview

	2015	2020	2025	2030
Estimated wideband data transmissions devices in EU28 Member States	739.5m	1,060m	1,564m	1,897m
Max market size by 2030	1,909m			Earliest date to market
				1990

⁸⁹ Kzero. 2014. <http://www.kzero.co.uk/blog/vr-headset-sales-forecasts-and-market-penetration-2014-2018/>

⁹⁰ Kzero. 2015. <http://www.kzero.co.uk/blog/consumer-virtual-reality-market-worth-13bn-2018>.

⁹¹ Statista. 2018. Forecast unit shipments of AR and VR headsets from 2019 to 2023 (in millions).

<https://www.statista.com/statistics/653390/worldwide-virtual-and-augmented-reality-headset-shipments/> Accessed 15th May 2019.

⁹² Research and markets. 2019. \$44.7 billion virtual reality market – global forecast to 2024. <https://www.globenewswire.com/news-release/2019/02/25/1741284/0/en/44-7-Bn-Virtual-Reality-Market-Global-Forecast-to-2024.html> Accessed 15th May 2019

Table 1.24: Wearable Routers

LE Spectrum 2.4 – 2.48, 5.15 -5.35, 5.47 – 5.725 GHz

Source	Summary of findings
1971 ⁹³	ALOHAnet connected the Great Hawaiian Islands with a UHF wireless packet network. ALOHAnet and the ALOHA protocol were early forerunners to Ethernet, and later the IEEE 802.11 protocols.
1999 ⁹⁴	The Wi-Fi Alliance formed as a trade association to hold the Wi-Fi trademark under which the first router products were sold.

Eurostat data provides information about connected households⁹⁵ and enterprises⁹⁶. From 2015 onwards it is not unreasonable to assume that each connected premise has a wireless router.

Calculation utilise EU28 Households (87 per cent connected in 2017) and Enterprise figures (97 per cent connected in 2017). Linear extrapolation of connectivity and increases in businesses and households enable forecasts to 2030.

		2015	2020	2025	2030
Estimated devices in EU28 Member States		208m	244m	272m	287m
Max market size by 2030	290m	Date brought to market			1999

Wideband data transmissions devices overview

		2015	2020	2025	2030
Estimated wideband data transmissions devices in EU28 Member States		949 m	1.304 b	1.830 b	2.180 b
Max market size by 2030	2.199 b	Earliest date to market			1990

⁹³ Official IEEE 802.11 working group project timelines.

⁹⁴ Wi-Fi Alliance: Organization". Official industry association Web site.

⁹⁵ Households - level of internet access [isoc_ci_in_h]

⁹⁶ Enterprise Internet access [isoc_ci_in_en2]