



Our Business Smart Hub:  
How we're substantiating  
our marketing claims



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# 1.1 Introduction

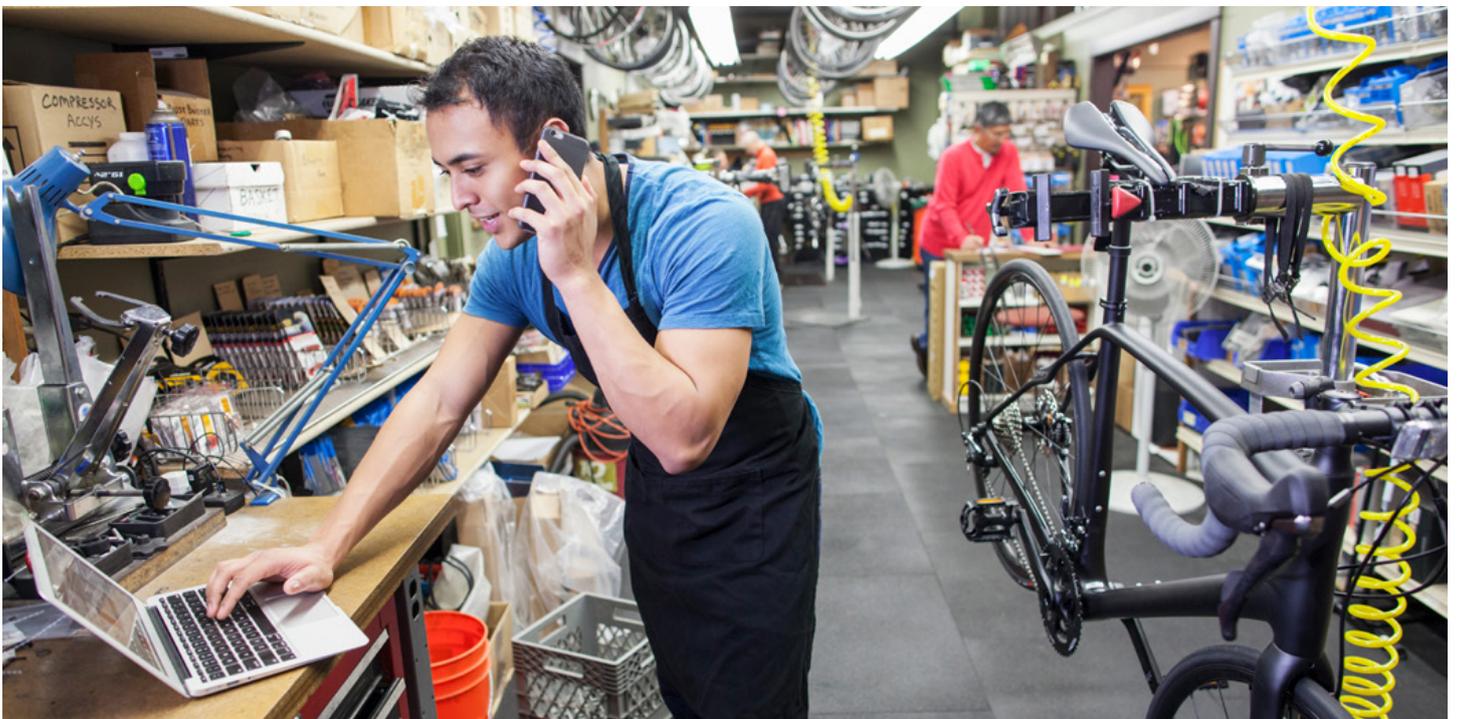
When compared to all other major UK business broadband providers, tests prove that our Business Smart Hub provides the best wi-fi coverage.

This report gives you an overview of the tests done both in the lab and on business premises. The results show that our Business Smart Hub always provides the best wi-fi coverage (defined as 'performance at range').

The tests were based on the IEEE802.11T method to make sure the data collected was reliable and the results repeatable. We also took into account previous Advertising Standards Authority (ASA) rulings and guidance on wi-fi performance claims.

**You should be aware that:**

- All devices tested were dual band (2.4GHz and 5Ghz), but this report focuses on showing the results for 2.4GHz only, as this band gives the best coverage.
- The test devices used for measuring performance were representative of those typically owned and used by businesses. The same devices and situations were used when testing our competitors' routers.
- The tests recorded speeds for normal user tasks.
- Turntables were used to make sure the test was fair, to make sure the routers weren't biased towards a particular direction and the test results weren't affected by the direction the router was pointing in.
- Hundreds of data-points were captured to make sure the results were repeatable and reliable. Once the superiority of our Business Smart Hub over competitor versions had been confirmed under lab conditions, further testing took place in ten real business premises, of different construction types. This was done to show that the results found in the lab weren't a one-off but could be replicated in typical business environments.



## 1.2 How we tested the most powerful business wi-fi

### 1.2.1 Routers tested: Devices under Test (DuT)

Table 1 shows the routers we tested, including our Business Smart Hub and ones from competitor Internet Service Providers (ISPs).

**Table 1 – Routers tested, DuT**

Business ISP	Router model
<b>BT</b>	Business Smart Hub
<b>Zen</b>	FRITZ! Box 3490
<b>Vodafone</b>	Vodafone Connect (Huawei HHG2500)
<b>TalkTalk</b>	Huawei HG633
<b>XLN</b>	Technicolor Media Access TG589vac v2
<b>Virgin</b>	Hitron CGNV4-BIZ

### 1.2.2 What we measured

To find the best wi-fi performance at range, we measured the Transmission Control Protocol over IP (TCP/IP) throughput.

This is the amount of data transferred successfully from wi-fi device to the Local Area Network (LAN) interface in a given time period. It's usually measured in bits per second (bps), megabits per second (Mbps) or gigabits per second (Gbps).

TCP/IP throughput is the most meaningful 'real-world' wi-fi performance metric. It determines the user's experience when using applications, like browsing online, downloading files and transferring data around an office environment. In the next section, we explain how this data is collected every second (see 1.3 on page 8).

Table 2 gives you an overview of the impact of having good wi-fi performance and the difference it can make. The better the wi-fi performance, the better the experience is. For example, two Netflix HD (1080p) video streams (at the same time) need a minimum of 6Mbps to play successfully. So our Business Smart Hub would be the only router that could support this in Room 3 of our test house with home office – see page 9.

**Table 2 – Example of bitrates needs for services**

Bitrate (Mbps)	Streaming
<b>0.5</b>	High quality music
<b>1</b>	Web video, such as YouTube
<b>2</b>	Standard TV
<b>4</b>	2 x Standard TV
<b>6</b>	2 x Netflix 1080p HD video
<b>30</b>	UHD video
<b>60</b>	2 x UHD video
<b>90</b>	3 x UHD video

### 1.2.3 How we did the tests

We used 'Over-the-Air' testing. It's the most representative method for testing wi-fi performance because:

- it's a test method for a real business premises
  - it takes the wi-fi antennas into account (in terms of patterns, polarisation, isolation, and position)
  - real business devices are used in the test
  - it allows a consistent approach to compare different Access Point router hardware
  - it reflects how customers experience wi-fi.
- 

### 1.2.4 The devices we used

We tested the typical devices customers have in their business. The number of antennas and wireless specification are also typical of those used by customers.

- Typical 3x3 MIMO laptop – MacBook Pro with three antennas.
- Typical 1x1 MIMO Smartphone – Samsung Galaxy S4 with one antenna.

These devices represent the range of devices within customers' homes and businesses.

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### 1.2.5 Where we carried out the tests

#### Wi-fi test facilities

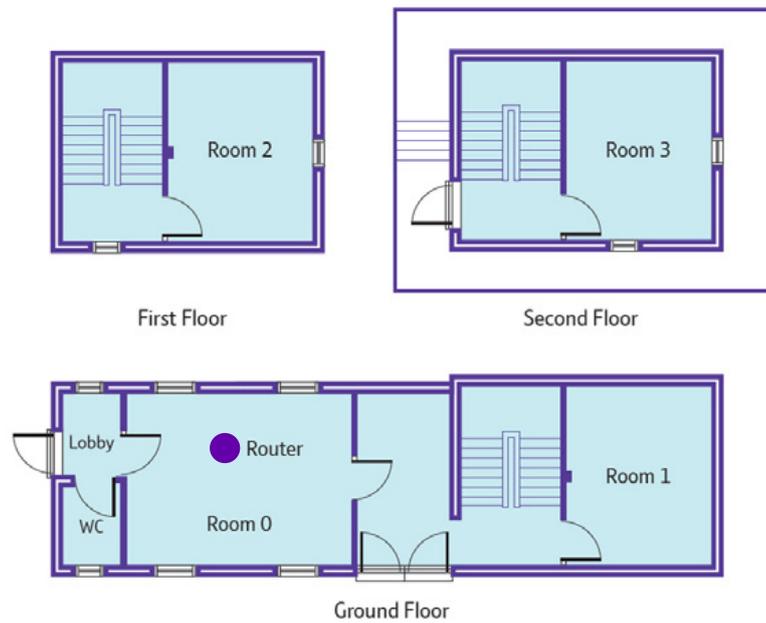
We completed tests over two stages in 11 test facilities.

- Stage 1: At our Adastral Park research facility.
- Stage 2: Inside ten real business premises.

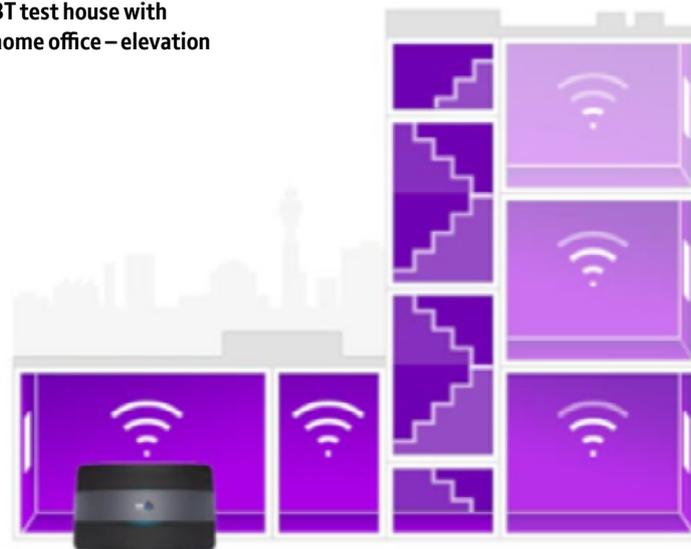
### 1.2.5.1 Adastral Park research facility

There's no wi-fi interference there. The building has rooms the same size as a large brick house with home office, and with the same reduction of signal strength the further away from the router a device gets, as a large brick house with home office. For this testing, the wi-fi coverage is the key variable. There are four test points inside the building, so we can test the wi-fi performance at different distances.

#### BT test house with home office – floor plan



#### BT test house with home office – elevation



**Table 3 – Rooms in the BT test facility**

Test Point	BT walls distance from link
Room 0	The same room the router is located
Room 1	The equivalent of one brick and two internal walls
Room 2	The equivalent of two brick and one internal walls
Room 3	The equivalent of three brick and one internal walls

This facility let us complete detailed and repeatable tests.

#### 1.2.5.2 Real business premises

We tested ten different real business premises to validate the test results from our Adastral Park research facility and give evidence that the tests truly represented the experience of UK businesses.

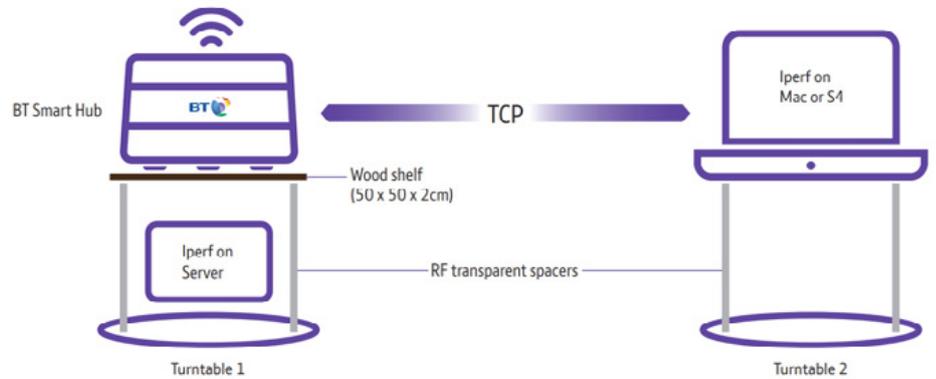
The buildings varied in size and construction, were fully furnished and exposed to everyday noise, interference and congestion from neighbouring networks of a typical business.

**Table 4 – List of real business premises tested**

Premises	Notes
<b>Small office block</b>	Brick building over two floors, built in the 1930's
<b>Workshop or lab</b>	Few wi-fi networks
<b>Three-bedroom house</b>	Home office in an old, three-bed house with thick walls, built around 1650
<b>Large office building</b>	Communal area of large office over two floors
<b>Four-bedroom house</b>	Home office in a four-bed house with a garden outbuilding
<b>Large detached thatched cottage</b>	Home office with no other wi-fi networks or neighbours and thick internal walls
<b>Theatre</b>	800 seat theatre and foyer with raked seating
<b>Restaurant</b>	Restaurant and conferencing rooms over two floors
<b>Exhibition hall</b>	The hall is within a huge building, similar to a large warehouse
<b>Bike shop</b>	Two-floor retail unit with offices and workshop

You can find floor plans for the ten real business premises in the Appendix. See page 14.

## 1.3 Test set-up



We put each router on a turntable and connected them to our server so we could generate the data needed for the throughput tests. Our test devices (laptop and smartphone) were also placed on turntables in each test room (the test points) and connected to each router using wi-fi. To create some data for testing over wi-fi from the server to our test devices, we used an application called iperf.V3. This let us control the tests and capture results.

For each test, we rotated the turntables and recorded the TCP upload and download throughput every second for a total of 480 seconds. We repeated this three times. During the test, the turntables were set at suitable rotation speeds that made sure each second represented a unique combination of angles for the router and device.



# 1.4 Results

## 1.4.1 Stage 1 – Results from controlled wi-fi test at our Adastral Park research facility

Our Business Smart Hub has the best performance in 100% of test scenarios when compared to all other routers tested. This includes download and upload on both the MacBook Pro and Samsung Galaxy S4, at all four distances (test points) tested.

Table 5 shows the percentage by which our Business Smart Hub is better than the next best result for each test in each room.

Table 5 – Coverage and performance testing summary of results

Test Room	Room 0 First test point	Room 1 Second test point	Room 2 Third test point	Room 3 Fourth test point
MacBook Pro – download	20%	18%	52%	182%
MacBook Pro – upload	1%	21%	98%	262%
Samsung Galaxy S4 – download	13%	20%	36%	83%
Samsung Galaxy S4 – upload	16%	17%	34%	*

\*For the Samsung Galaxy S4 upload test, no other ISP router was able to achieve a result so a percentage could not be calculated.

### 1.4.1.1 Stage 1 – Detailed results for the MacBook Pro – download

All rates are in Mbps.

Table 6 – MacBook Pro download results

Test Room	Room 0 The room the router is located and first test point	Room 1 Second test point	Room 2 Third test point	Room 3 Fourth test point
BT	159.00	152.00	92.90	9.29
Vodafone	98.20	96.73	43.53	0
Zen	119.10	114.00	51.08	3.29
TalkTalk	88.78	86.35	59.68	0.08
XLN	73.80	63.82	35.85	1.05
Virgin	132.2	128.5	61.05	0.255
Best of the other, non BT business ISPs	132.200	128.500	61.050	3.294
Percent better BT is	20%	18%	52%	182%

#### 1.4.1.2 Stage 1 – Detailed results for the Samsung Galaxy S4 – download

All rates are in Mbps.

Table 7 – Samsung S4 download results

Test Room	Room 0 The room the router is located and first test point	Room 1 Second test point	Room 2 Third test point	Room 3 Fourth test point
BT	63.93	64.99	35.74	5.30
Vodafone	46.5	30.1	17.4	0.81
Fritz Box	56.40	54.37	26.30	2.90
TalkTalk	41.83	41.53	21.87	0.8
XLN	35.48	33.48	15.68	0
Virgin	49.86	49.75	25.3	0
Best of the other business ISPs	56.4	54.37	26.3	2.9
Percent better BT is	13%	20%	36%	83%

#### 1.4.1.3 Stage 1 – Detailed results for the MacBook Pro – upload

All rates are in Mbps.

Table 8 – MacBook Pro upload results

Test Room	Room 0 The room the router is located and first test point	Room 1 Second test point	Room 2 Third test point	Room 3 Fourth test point
BT	160.10	133.90	56.70	4.42
Vodafone	103.00	77.63	22.47	0
Zen	158.60	110.30	28.68	1.22
TalkTalk (Business)	69.79	49.17	23.76	0.24
XLN	97.64	62.29	21.82	0.39
Virgin Business	154.4	46.44	15.635	0.015
Best of the other, non BT business ISPs	158.6	110.3	28.68	1.22
Percent better BT is	1%	21%	98%	262%

#### 1.4.1.4 Stage 1 – Detailed results for the Samsung Galaxy S4 – upload

All rates are in Mbps.

**Table 9 – Samsung Galaxy S4 Upload Results**

Test Room	Room 0 The room the router is located and first test point	Room 1 Second test point	Room 2 Third test point	Room 3 Fourth test point
BT	70.05	67.34	40.44	7.07
Vodafone	46.5	30.1	17.4	0
Zen	60.19	57.39	30.23	0
TalkTalk	49.5	45.7	21.5	0
XLN	53.42	49.55	20.80	0
Virgin	58.22	52.54	22.7	0
Best of the other business ISPs	60.19	57.39	30.23	0
Percent better BT is	16%	17%	34%	*

\* For the Samsung Galaxy S4 upload test, no other ISP router was able to achieve a result so a percentage could not be calculated.

#### 1.4.2 Stage 2 – Results from inside real business premises

The three routers that performed the best in Stage 1, were our Business Smart Hub, Zen FRITZ! Box 3490 and Virgin Hitron CGNV4-BIZ. We took these in to Stage 2 of testing.

##### 1.4.2.1 Medal table

**Table 10 – Medal table ranking wi-fi performance of ISP routers**

Position	ISP and router	Comments
1st Place	BT Business Smart Hub	Best wi-fi for 100% of test scenarios
2nd Place	Zen FRITZ! Box 3490	0% first place and 75% second
3rd Place	Virgin Hitron CGNV4-BIZ	0% first place and 19% second

##### 1.4.2.2 Stage 2 – Results summary

The Business Smart Hub has the best performance compared to all other routers tested in 100% of test scenarios. And it was tested at different distances inside ten different buildings and wi-fi environments.

### 1.4.2.3 Stage 2 – Detailed results

The following table shows the results from the ten real business premises. For each premises download test was performed, results are in Mbps.

Table 11 – Multiple tables showing all results from real business premises tests

		BT	ZEN	Virgin	Best
Premises 1 Small office	Test point 1	137.67	116.33	126.67	BT
	Test point 2	75.6	45.1	35.73	BT
	Test point 3	33.63	11.88	3.02	BT
Premises 2 Workshop or lab	Test point 1	147	112	122	BT
	Test point 2	118	80.7	67.6	BT
	Test point 3	117	75.3	83.2	BT
Premises 3 Three-bedroom house	Test point 1	140	76	90.8	BT
	Test point 2	103.3	69.13	84.63	BT
	Test point 3	83.97	79.07	56.93	BT
Premises 4 Large office building	Test point 1	56.4	38.6	34.1	BT
	Test point 2	10.1	8.52	2.25	BT
	Test point 3	6.61	4.08	2.12	BT
Premises 5 Four-bedroom house	Test point 1	107.97	83.37	67.87	BT
	Test point 2	74.4	65.37	22.6	BT
	Test point 3	65.67	49.5	18.06	BT
Premises 6 Large detached thatched cottage	Test point 1	163.33	137.67	141	BT
	Test point 2	24.93	0	0.65	BT
	Test point 3	0.31	0	0.2	BT
Premises 7 Theatre	Test point 1	138.33	118.67	114	BT
	Test point 2	134.33	112.67	106.67	BT
	Test point 3	22.46	7.23	10.15	BT
Premises 8 Restaurant	Test point 1	151	76	129.67	BT
	Test point 2	46.87	22.1	16.8	BT
	Test point 3	73.93	66.1	54.57	BT
Premises 9 Exhibition hall	Test point 1	58.53	42.8	23.33	BT
	Test point 2	46.3	28.23	6.57	BT
	Test point 3	19.63	17.17	0.67	BT
Premises 10 Bike shop	Test point 1	125.33	96.93	95.17	BT
	Test point 2	131.67	122.33	116.33	BT
	Test point 3	65.6	55.33	44.53	BT

## 1.5 Conclusion

The tests we carried out in stage 1 on our Business Smart Hub and the major ISP routers were repeated many times to make sure the results were a fair reflection of their wi-fi performance and coverage. And for 100% of the tests, our Business Smart Hub was the best performing wi-fi router.

The top three ISP routers (BT, Zen and Virgin) were then re-tested in ten real business premises and our Business Smart Hub performed the best in 100% of these tests too.

In conclusion, we've shown our Business Smart Hub consistently delivers the UK's best wi-fi coverage, outperforming routers from all major UK business broadband providers.



# 1.6 Appendix

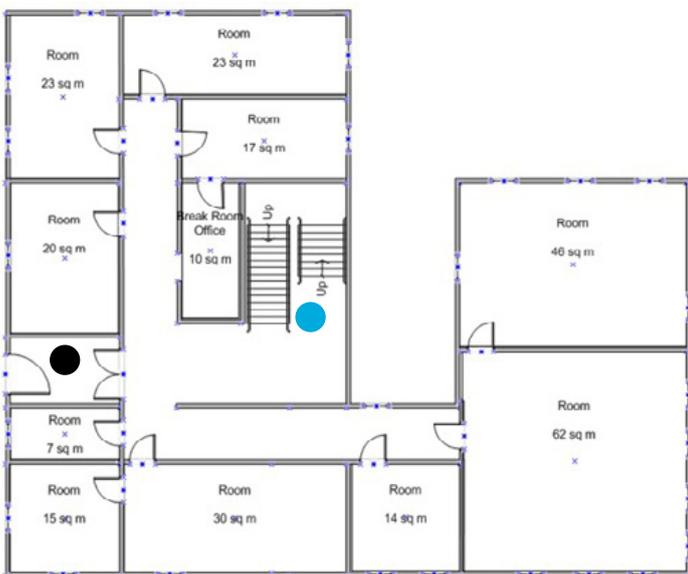
## 1.6.1 Floor plans

Table 12 – List of premises

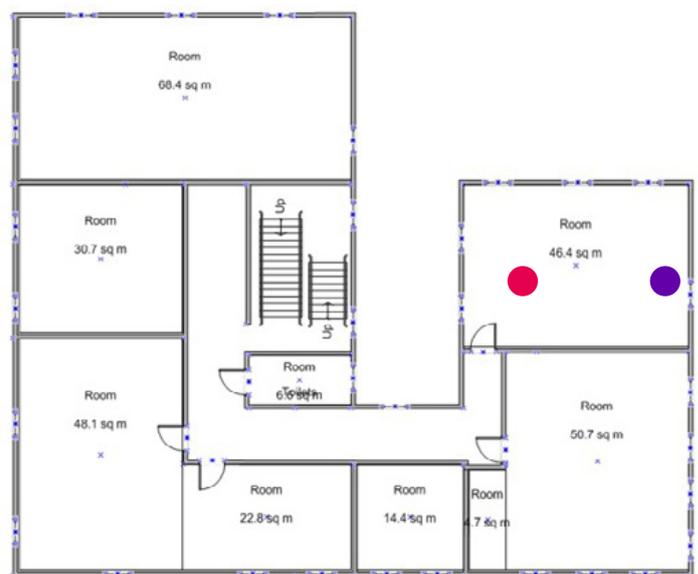
Premises	Notes
Small office block	Brick building over two floors, built in the 1930's
Workshop or lab	Few wi-fi networks
Three-bedroom house	Home office in an old, three-bed house with thick walls, built around 1650
Large office building	Communal area of large office over two floors
Four-bedroom house	Home office in a four-bed house, with a garden outbuilding
Large detached thatched cottage	Home office with no other wi-fi networks or neighbours and thick internal walls
Theatre	800 seat theatre and foyer with raked seating
Restaurant	Restaurant and conferencing rooms over two floors
Exhibition hall	The hall is within a huge building, similar to a large warehouse
Bike shop	Two-floor retail unit with offices and workshop

### 1.6.1.1 Small office

Brick building over two floors, built in the 1930's



Ground floor

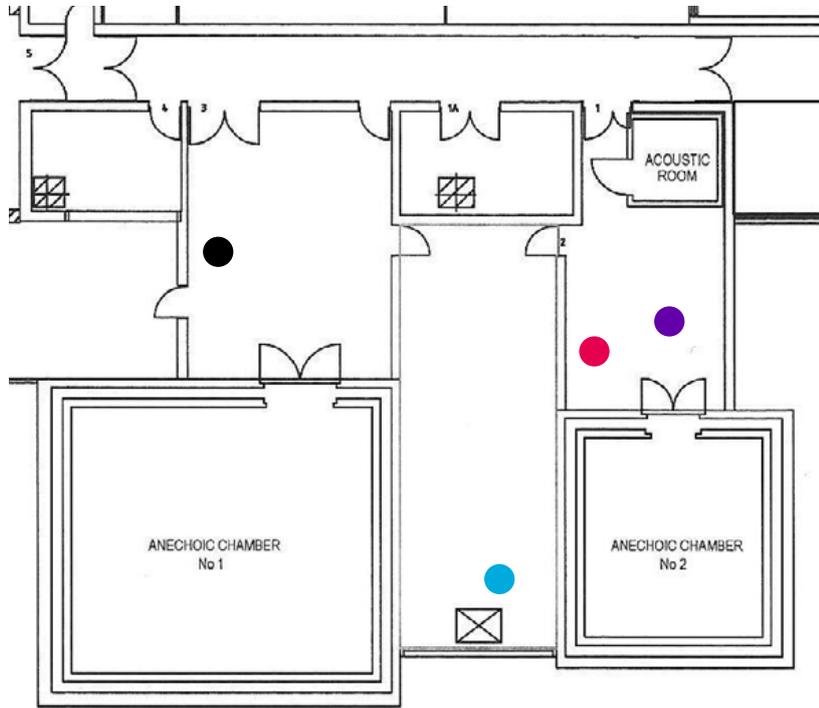


First floor

- Router
- Test point 1
- Test point 2
- Test point 3

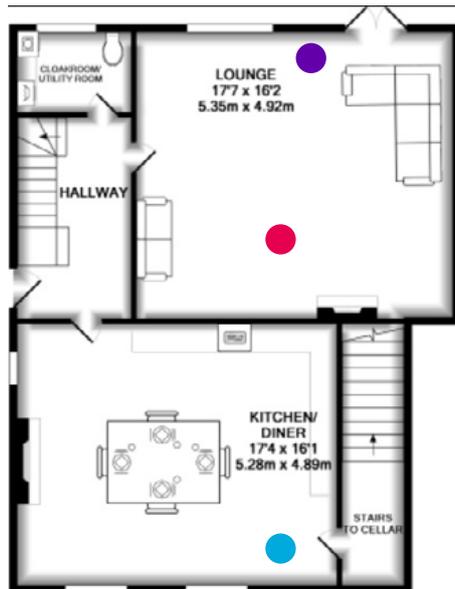
1.6.1.2 Workshop or lab

Few wi-fi networks



1.6.1.3 Three-bedroom house

Home office in an old, three-bed house with thick walls, built around 1650



Ground floor

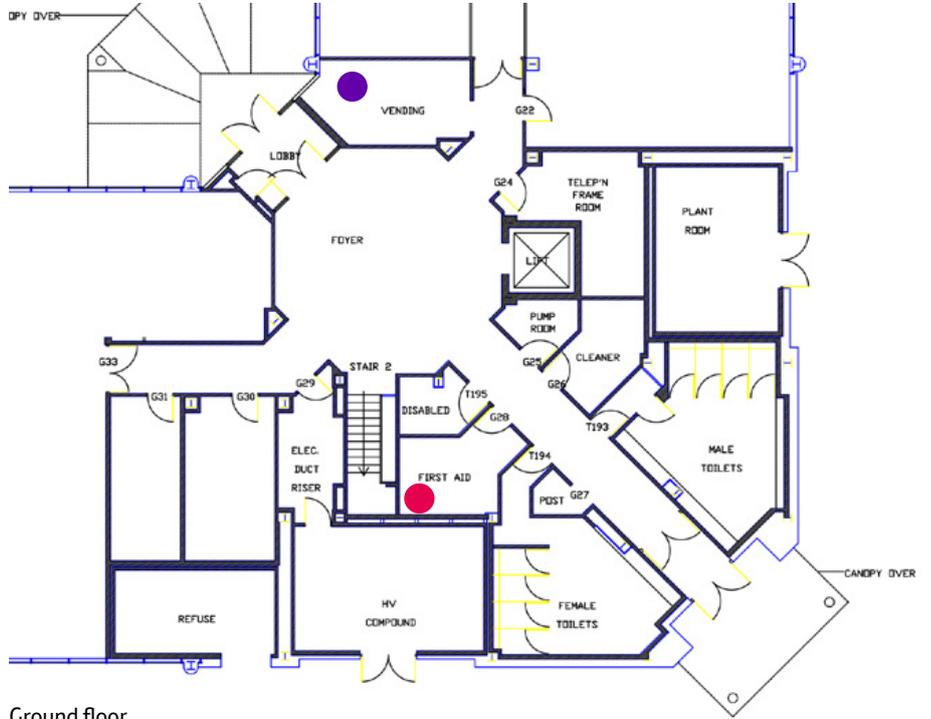


First floor

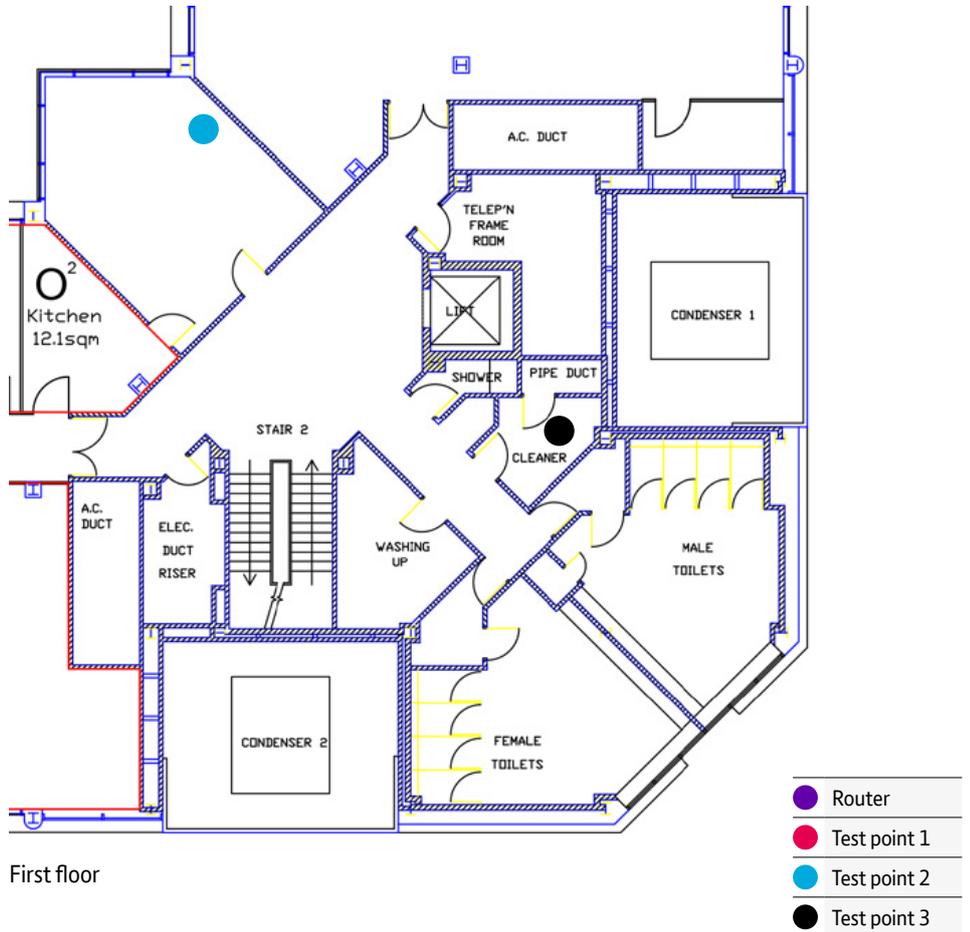
- Router
- Test point 1
- Test point 2
- Test point 3

1.6.1.4 Large office building

Communal area of large office over two floors



Ground floor



First floor

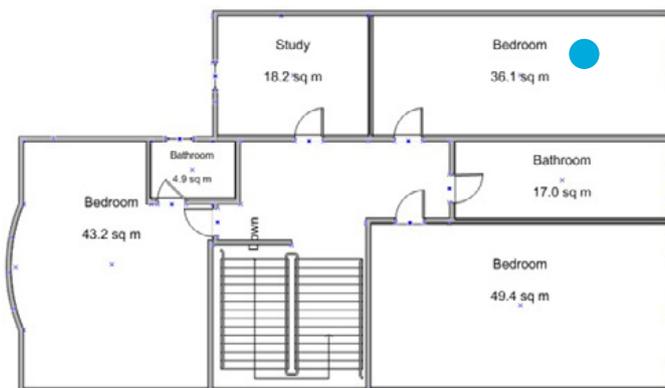
- Router
- Test point 1
- Test point 2
- Test point 3

1.6.1.5 Four-bedroom house

Home office in a four-bed house with a garden outbuilding



Ground floor



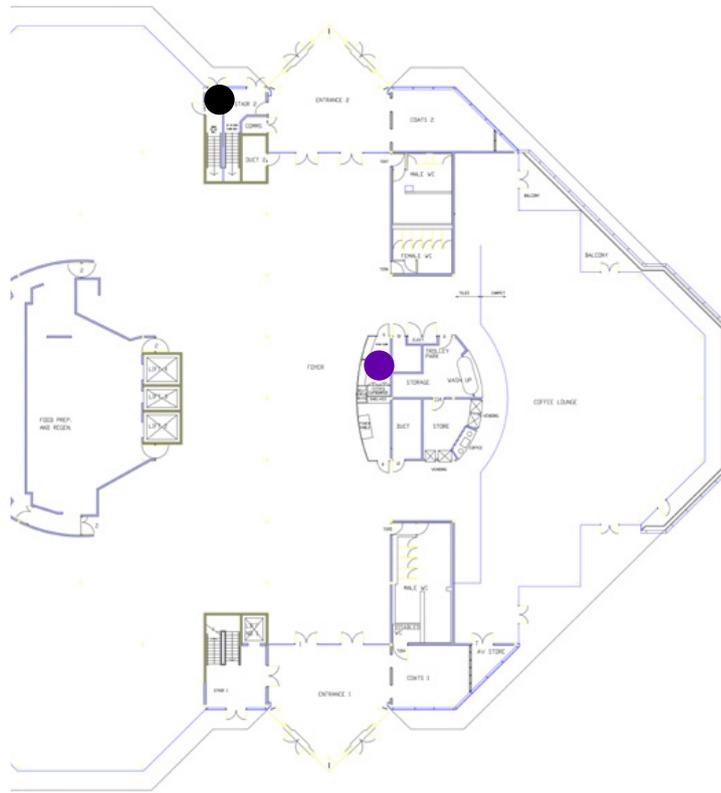
First floor

- Router
- Test point 1
- Test point 2
- Test point 3

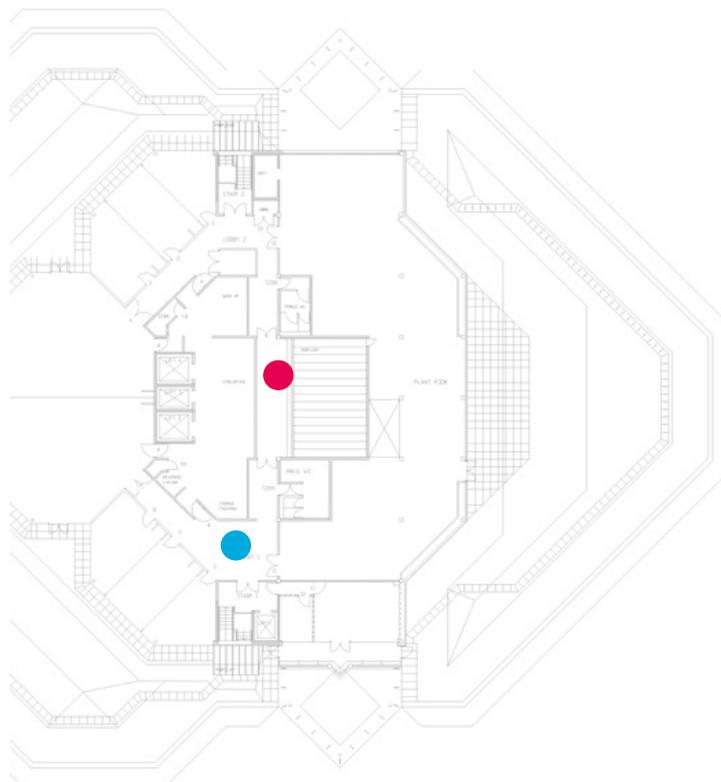


1.6.1.8 Restaurant

Restaurant and conferencing rooms over two floors



Ground floor



First floor

1.6.1.9 Exhibition hall

The hall is within a huge building, similar to a large warehouse



1.6.1.10 Bike shop

Two-floor retail unit with offices and workshop



Ground floor

First floor

- Router
- Test point 1
- Test point 2
- Test point 3

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