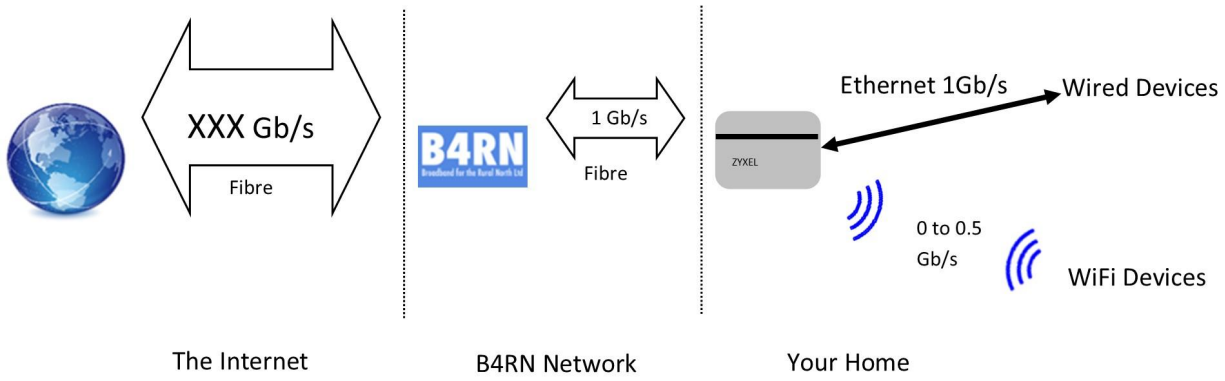
How to ensure fast internet in every room of your home.

B4RN delivers very high speed broadband (1 Gigabit/second(Gb/s)) to the router in your home. However, it is up to you to get the best out of it and decide how to connect your personal devices to it, either wired or wirelessly. Wireless networking is all well and good if you are close to your router, but move ten feet further away and add a wall between you and the router and wireless speeds will start to drop. Even the newest wireless devices will have trouble with bricks and mortar, insulation and cinder-block properties... Add a ceiling with metal backed plasterboard into the mix and you may well find your high speed connection isn't. WiFi will not go through water or metal, but it can often bounce around and get into different areas of your house.

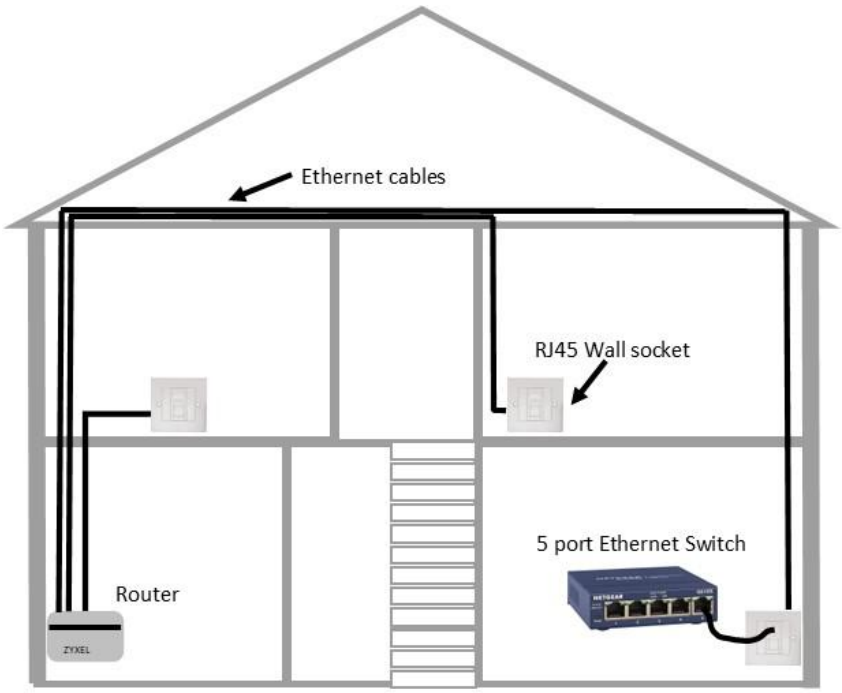
The Router has four Gigabit/second (1000 Megabit/second(Mb/s)) ethernet ports for plugging in wired connections and provides WiFi for wireless connections. The nature of WiFi is such that it is impossible to guarantee exactly how well the Router WiFi signal will travel around your house, each home is different. Even under perfect conditions the very best WiFi connection to the router will be less than 500Mb/s and more typically 50-150Mb/s, but with distance and obstacles it will quickly fall to zero. WiFi is an amazing technology with many useful features, but consistent performance under all circumstances isn't one of them.



How to decide, Wired or WiFi?

The only **guaranteed** way of ensuring every part of your house has access to the full 1Gb/s B4RN internet connection is to use physical cabling, which these days comes in various grades called "Cat" (short for "Category") followed by a number. In very simple terms, the bigger the number, the faster speed the cable will support. In practice, you do not need anything above Cat5E or Cat6 for a domestic installation. Installing Cat5E or Cat6 ethernet cable is the recommended approach; it has a similar appearance to TV aerial Coax, but contains 8 wires. Modern ethernet devices support 1Gb/s speeds over distances of up to 100metres and sometimes a little more. If you are a moderate DIY'er, it's a simple task to install (drill holes, use cable clips, etc., bearing in mind that Ethernet cable has a minimum bend radius and should not

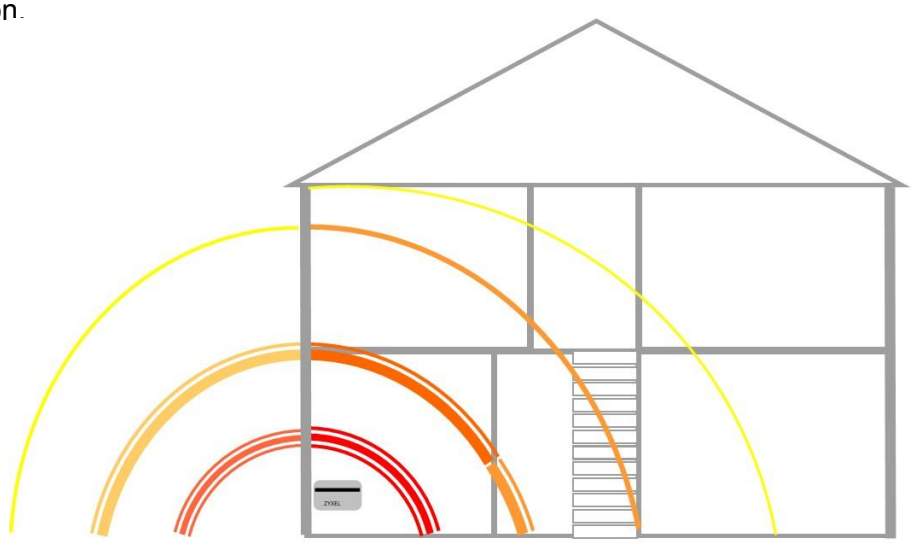
be stapled down) and terminate (put plugs or sockets on the ends) ethernet cabling (widely available crimp tool for plugs and “punchdown” tool for sockets). It is also possible for the Ethernet to be taken out of the house (using special “exterior grade” cable) through a wall or window, and taken back into the other end of the house rather than disrupt indoor decorations. If DIY isn’t your thing then perhaps you could ask a friend or neighbour to help or perhaps employ a contractor. Once installed, ethernet cable provides a consistent method for accessing the Internet. An ethernet connection is the best option for supplying fixed position devices, e.g. TV’s or desktop PCs with the fastest connection, but it’s also really useful for providing the physical connection point for WiFi Access Points that in turn allow wireless connection to mobile or hand-held devices.



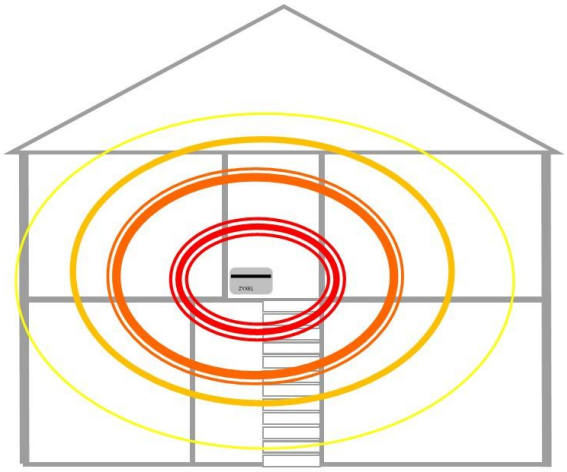
The diagram above shows a typical house with the router located on a ground floor wall, a typical ethernet cable and a wall socket. In the house, three out of the four available ports on the router have been wired to 3 wall sockets around the house. A device called an ethernet switch can use one wall socket connection and make it into 4 sockets (properly called “ports”) or more, ideal for connecting a TV, Streaming box, gaming console etc. It is possible to further extend and increase the number of connections in a wired network by using additional switches (they can be “daisy-chained” more or less indefinitely). The smallest switches have 4 ports, but 8, 12 and 16-way are common.

If you do not want the disturbance of running dedicated ethernet cables around your home, there is an alternative. Network Powerline adapters (aka “Ethernet over power”, **NOT** “power over ethernet”, which is something completely different!) use the existing household electrical wiring rather than dedicated ethernet cabling, but typical speeds will be <5-10% of those achievable on ethernet; that may be adequate for your needs though. The adapters plug into a mains socket and an ethernet lead connects the router and destination devices to their adapter.

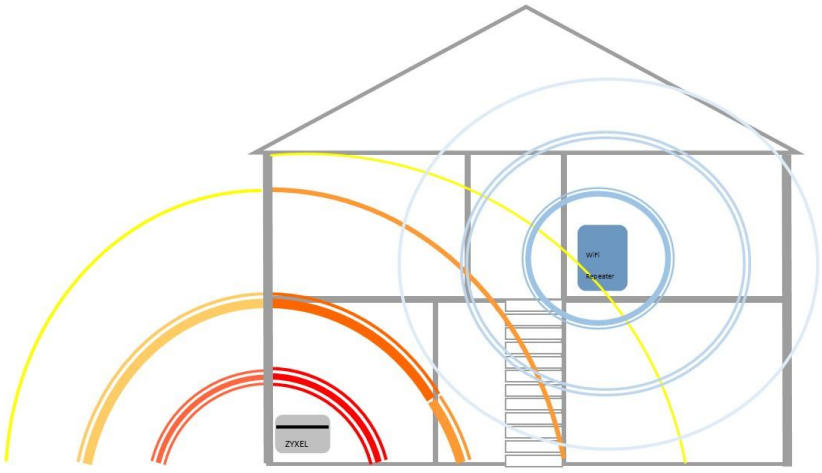
However, relying on a single device like the Router can prove disappointing in terms of connection speed and consistency of coverage. You can improve the quality and range of WiFi coverage by careful location choice, but it's often much better to consider adding individual WiFi Access Points or better still a Mesh WiFi for larger properties or those with difficult layouts or thick internal walls. One way to help understand the limits of WiFi is to use a candle analogy. Imagine the WiFi transmitter is a candle in a dark room and the receiver is a piece of A4 paper with writing on. A few centimetres from the candle the piece of paper will appear well lit, if you move it 1 metre away the writing will be poorly lit, 10 metres away and the paper will be barely visible. The intensity of light produced by the candle hasn't changed; it's just that the "amount" reaching the paper reduces with distance. WiFi fades out with distance, and won't pass through metal backed insulation or thick old walls. The next few diagrams show some options on how to improve your WiFi coverage; spoiler alert - for most properties a Mesh will offer the best overall solution.



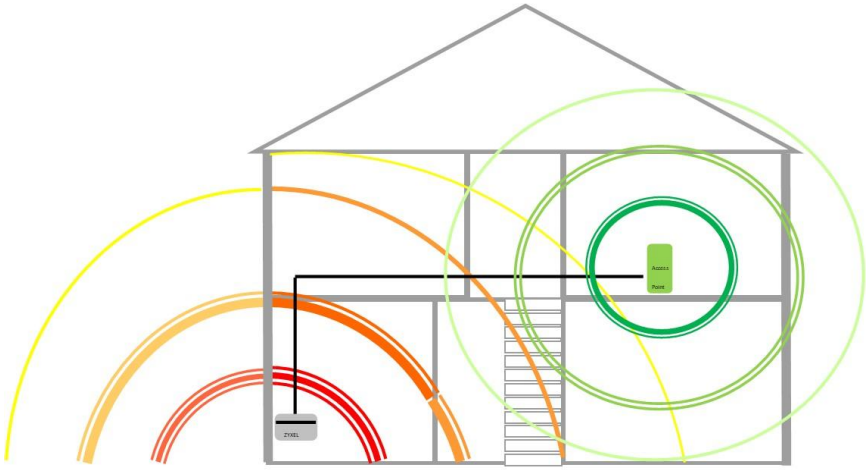
The above figure shows a typical brick-built house with stud internal wall, with the router mounted low on an external wall. The WiFi has a strong signal in the adjacent rooms and even outside, but the furthest rooms only get a weak signal and hence poor connection speeds. .



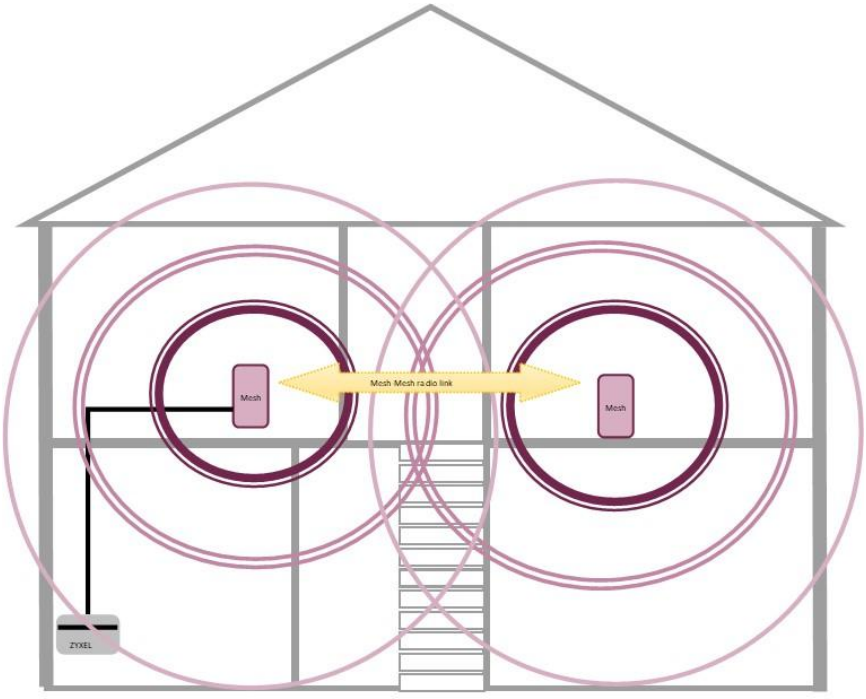
If the B4RN fibre can be routed to it and power is available then a centrally located router will ensure better coverage on both floors and around the house. However, the peripheral rooms will still have slower WiFi speeds than those adjacent to the router. If you go to extra time and trouble to get the router into the centre of your home you may still find areas without a good enough signal to stream video.



The figure above shows a WiFi booster has been added. Prior to Mesh WiFi becoming widely available, the only wireless approach was to use a device variously called “a WiFi booster/repeater/range extender”. Although manufacturers use the names interchangeably and some of the exact details of how individual devices work will vary, these devices connect to the Routers WiFi and then broadcast a separate signal thus extending the coverage. Some boosters will rename the new WiFi, others will use the same name as the Routers WiFi. The vast majority of boosters all share the same fundamental flaw; they halve the available connection speed for devices using the WiFi.



In the figure above a secondary WiFi Access Point (“AP”), located on the first floor, is connected by ethernet to the router. This means the AP has access to the full 1Gb/s available from the router, The AP WiFi now provides access to the internet in the rooms of the house not well covered by the router WiFi. However, there are now two WiFi signals in the house and it can cause confusion over which one to connect to and sometimes devices remain connected to the weaker of the two signals even though there is a better option. Some wired, fully featured AP’s, will actually provide better WiFi coverage and speed than the router itself.



In the figure above a Mesh WiFi setup is shown. The first unit is connected to the router via ethernet cable. Once powered and transmitting the second unit is placed so that it can wirelessly link to the first unit. Most Mesh systems have simple LED indicators to show how well

the connection between units is performing, so that their position can be adjusted. Some Mesh systems rely upon the same WiFi channel to connect the Mesh points as they then use to share around the home, more capable systems will have a dedicated wireless link for connecting the Mesh points- usually referred to as “tri-band”, the simple systems are referred to as “dual band”. Some Mesh units also have the option of replacing the wireless link between them (called the “backhaul”) with an ethernet cable. The combination of the Mesh units ensures a much larger area of the property receives a strong single WiFi signal. Additional Mesh units can be added in some systems, typically 3-6 is the maximum number. To simplify the WiFi environment inside the house, it is advisable to switch off the router WiFi which can be simply achieved using a button pon the outside of the router.

A number of volunteers run a “club” on Zoom, every Friday, 2pm-4pm and on the first Wednesday of the month, 7pm-9pm. We can help you decide what to try, just email pr@b4rn.org.uk for an invite.

If you have a Facebook account, we also have a Facebook Group where you can ask questions; https://www.facebook.com/groups/b4rncomputerclub

The Pros and Cons of the different approaches.

Approach	Pros	Cons
Ethernet	* Guaranteed to get full speed service and scope for future 10Gb/s. *Consistent high speed to a fixed point. * Low material costs, cable 30p/metre, £3 for wall sockets, Simple network switch £25 * Can act as backhaul (the “backhaul” is how the Mesh units talk among themselves) for Mesh WiFi. or a WiFi AP (“Access Point”) * Multiple connections can be added with a Switch.	* Cabling existing property is time consuming. * DIY skills or contract labour costs are unavoidable. * Cable positions are fixed. * Changes/additions are time consuming. * Risk of physical damage to embedded cables.
Powerline adaptors	* No new cabling around the house needed. * Simple to use and install. *Moderate costs, start ~£30 for two. *The remote adaptor can also have WiFi AP built in, start ~£50 for two	* Actual internet speed is typically in 10-100Mb/s range. Performance depends on household wiring standard, so highly variable. *After power cuts they don’t always reconnect to router/internet correctly.
WiFi Repeaters/ *Booster	* A low cost solution (~£30+) but with limitations. * No additional wiring required.	*WiFi Connection speed is automatically reduced by 50% and by far more if incorrectly sited, * After power cuts they don’t always reconnect to router/internet correctly * Second WiFi can cause confusion for householders.

Wired , WiFi Access Points	* A wired AP has access to the full Gb/s ethernet feed, improving potential performance of the WiFi it subsequently transmits. * The wired AP can be a reconfigured second-hand router- a cheap/ reuse option. * The wired AP can provide WiFi and also be an ethernet switch. *Ethernet cable can also be used to provide power to the AP, particularly useful for externally mounted AP's. *Some APs achieve better WiFi speeds than the router WiFi, prices start from £25 for a basic to £300+ for high specification units.	* Having a second WiFi can cause confusion for some householders. * All the cons of installing ethernet cables. * Configuration and Network management of the AP isn't always turn-key and can require some user input to set up.
Mesh	* A Mesh generates a single WiFi signal around the property. * Additional Mesh points can be easily added * Only the first unit connecting to the router requires a cable * Some Meshes allow ethernet to link them to improve the overall performance. * App's now mean setting up a Mesh requires much less technical knowledge than an Access Point. *Prices start from ~£75 and go to £1000+, but even the lower price systems can bring big improvements over just relying on Router WiFi.	* The WiFi speeds achieved by a Mesh will still be limited by how well the Mesh units wirelessly link to one another. The same problem of thick walls etc exists. Thoughtful positioning helps. * Each Mesh unit requires a mains power point and a good location to link to others.