Y **Hacker News** new | threads | comments | show | ask | jobs | submit   hipjiveguy (6) | logout

ESP 8266 Wi-Fi Repeater with Mesh Networking (github.com)

359 points by rcarmo 10 hours ago | hide | past | web | favorite | 135 comments | instapaper

[add comment]

acidburnNSA 10 hours ago [-]   [+]

escapologybb 10 hours ago [-]   [-]

Here's a quick question I hope somebody can shed some light on. I live in a small-ish town in Yorkshire, probably a couple of miles square and was wondering about the feasibility of using these little devices to create a mesh network to extend my home network.

The reason being is that I have lots of Internet connected devices which watch over me whilst I'm in the house, being Quadriplegic it's much more comforting to have a computer watch over my health and do things for me than it is to have a potentially tired, angry and/or bored person doing it. However, that bubble ends as soon as I pass out of Wi-Fi range.

So obviously I would like to extend coverage to cover my smalltown, but everything I've seen so far has been prohibitively expensive. It wouldn't need to have a massive amount of bandwidth available as it would be just me using it, but it would need to be fairly cheap and as near to 100% reliable as possible.

Any insights, questions, comments? TIA

Edited To Add: I've just measured it using Google Earth and I need to cover a circle with an area of about one square kilometre.

reply

> j_s 7 hours ago [-]   [-]
>
> LoRaWAN packet received at record distance of 702 km | https://news.ycombinator.com/item?id=15201692
>
> Specifically mention of two Ubiquiti M900 (~$130 each) for line-of-sight internet from home.
>
> Related discussions:
>
> https://news.ycombinator.com/item?id=15246659
>
> https://news.ycombinator.com/item?id=15480551
>
> reply
>
> sputr 9 hours ago [-]   [-]

Maby contact these guys: https://wlan-si.net/en/

They are(were) deploying wifi mesh networks on the cheap in Slovenia. They've covered entire towns that did not have internet access in the past (mesh network in the town + string of directed antenna to get an uplink from a bigger town). Routers they used cost in the range of 15€ each, but the last time I talked to them they had trouble supplying new routers.

reply

> escapologybb 9 hours ago [-] [-]
>
> Thanks for the link, I will definitely get in touch with them. Paying for the equipment isn't the issue I don't think, it's the expertise and looking for.
>
> reply

mschuster91 10 hours ago [-] [-]

Uhhhh. I'd take a look at LoRaWAN or SigFox technology, but that needs appropriate support in your IoT stuff.

The alternative would be a small battery-powered 4G hotspot like the Huawei E5573CS-322.

reply

> escapologybb 9 hours ago [-] [-]
>
> I had never heard of either of those two technologies but I would definitely do some googling now, thanks for the tip.
>
> I would rather avoid a 4G hotspot attached to my wheelchair for a couple of reasons, chief among them is the data costs would be really high. If I were to extend my home Wi-Fi network I've already paid for my Internet connection, I'm just making my home Wi-Fi network WAY BIGGER than it was intended to be. :-)
>
> reply
>
> > mcroydon 9 hours ago [-] [-]
> >
> > The Heltec WiFi LoRa 32 (http://www.heltec.cn/project/wifi-lora-32/) and clones are a solid place to start if you want to investigate LoRa. Pycom (https://pycom.io) has several chips including one that does both LoRa and Sigfox.
> >
> > Espressif also have a shorter distance but lower power option that uses WiFi tech called ESP-Now that is worth looking at: http://espressif.com/en/products/software/esp-now/overview
> >
> > reply
> >
> > > bicubic 8 hours ago [-] [-]
> > >
> > > Your links sent me down a rabbit hole of Iot stuff and now I'm super excited about it. Had no idea that lte-m is so widespread.
> > >
> > > It's only a matter of time before it's easier and cheaper to get any kind of networked devices onto a carrier network than the users wifi. The implications are kinda scary though: does this mean it's only a matter of time before the majority of personal devices talk to their users with a telco/govement middle man network?
> > >
> > > reply

jacquesm 9 hours ago [-] [-]

Is a cell phone based system an option?

Reliability is going to be the hard part.

reply

escapologybb 9 hours ago [-]   [-]

It's not totally out of the question but from what I can see it would be prohibitively expensive after a while, whereas an upfront cost for some low-cost networking hardware that would then get its Internet connection from my home router would be much cheaper in the long run. I think.

reply

clort 8 hours ago [-]   [-]

I bought a huawei 4g mobile wifi device off ebay for about 25 quid earlier this year, and have a 3 sim card (the huawei device is branded 3 anyway, but they don't lock them) with 20Gb/mo data for 15/mo but you can get cheaper contracts since you don't need that much data. I run it from 12v, pretty sure you could mount it on an electric weelchair..

reply

pwaai 6 hours ago [-]   [-]

curious how much you are paying for 15GB / month? just wanted to compare with Canada.

reply

clort 6 hours ago [-]   [-]

sorry I forgot the pound sign don't show on HN ..its 15 pounds sterling per month for 20GB

reply

pwaai 6 hours ago [-]   [-]

ah no worries...just wanted to see how much we are behind the rest of the world.

so 15 pounds in CAD is ~ $25

so 15 pounds for 500mb/month in Canada...

reply

driverdan 8 hours ago [-]   [-]

If you're not using a lot of data a mobile phone is a great way to do it. Low end Android phones are cheap and surprisingly powerful. Prepaid phone plans are inexpensive.

reply

michaelt 7 hours ago [-]   [-]

ee pay as you go offers 100mb for 30 days for £3.

Gonna be hard to beat that, cost-wise, with anything reliable and covering a large area.

reply

kingosticks 7 hours ago [-]   [-]

Cost-wise Three.co.uk/datareward is pretty good. 200mb free every month.

reply

Corrado 3 hours ago [-]   [-]

I'm trying to view the recent FCC Net Neutrality reversal in a positive light; will it finally force us to abandon traditional ISPs? Building a mesh seems like the proper solution to ISPs that won't treat our packets with respect. Given the correct cost/performance ratio I think we could see a mass of tiny devices scattered around the neighborhood/town/city/state/country with backhauls in as many places as possible.

If they are cheap enough and self configuring then we could just plug them in to any available electrical outlet and go. Put a couple in your house and put a couple in your parent's/sister's/cousin's house. Talk to your neighbors and have them plug a couple in. Head to the local taco place and have them plug a couple in. It shouldn't be hard to get everyone on board: "Plug this in and get free {libre|beer} Internet access!"

reply

kees99 10 hours ago [-]   [-]

Two limitations here are worth keeping in mind:

- Throughput is not stellar (less than 1 mbit/s in a realistic setup);

- This is not a real IEEE 802.11s mesh, but rather some clever mechanism on how a node can select an "uplink".

reply

> StavrosK 10 hours ago [-]   [-]
>
> Thanks for pointing that out. I'd also like to point out that the ESP8266 is a $2 stamp-sized MCU, and it's all you need to run this.
>
> Here's the smallest breakout for the ESP8266 that I know of, one I made: https://github.com/skorokithakis/tiny-ESP8266-breakout
>
> You'll need to connect a 2-3 resistors to the ESP to get it to boot, and that breakout makes it easy. Or you can buy a WeMos D1 mini, which has a USB to serial adapter on it as well, and makes things much easier.
>
> reply
>
> > jacquesm 9 hours ago [-]   [-]
> >
> > Very neat!
> >
> > reply
> >
> > > StavrosK 9 hours ago [-]   [-]
> > >
> > > Thanks, Jacques! It came in handy, as it's the only one that would fit in my bus stop bus project:
> > >
> > > https://www.makerfol.io/project/3VanQzA-the-bus-stop-bus/bui...
> > >
> > > The alternative would be to have all the resistors and capacitors floating in the case, so it's much more tidy. Plus it's very fun to route.
> > >
> > > reply
> > >
> > > > jacquesm 7 hours ago [-]   [-]
> > > >
> > > > I absolutely love your little projects. Especially can't wait until that phone is finally done. Cue the next meeting where - to the sound of loud ringing - you pull an old fashioned phone out of an oversized pocket and start talking :)
> > > >
> > > > reply

StavrosK 7 hours ago [-]   [-]

Thank you! That's been done for years, though :) I've had more than a few stares, and people even came up and asked me if it was actually working. I even made a PCB for it, so it's much easier to convert a rotary phone to a mobile (haven't tested that yet, though).

Unfortunately, the ringer was too high-voltage to make work, and the Arduino wouldn't fit inside the phone unless I took out the ringer. Maybe the new PCB will fit, I'll have to try it out. Maybe I'll send you the next prototype unit as a gift, if I ever complete it (or, if you're ever in Greece, drop me a line and we can build it together!).

reply

> jacquesm 6 hours ago [-]   [-]
>
> Ah, I thought it was still work in progress.
>
> > the ringer was too high-voltage to make work
>
> But they don't use a lot of current. It's about 90V AC iirc to make it properly ring, and 20 Hz, you could do that with a switched capacitor network or, alternatively, by using a step up transformer (will be a bit heavier). Ugly solution would be to re-wind the coil so it works on a lower voltage and drive it directly.
>
> reply
>
> > StavrosK 6 hours ago [-]   [-]
> >
> > Yeah, it's definitely doable on battery, it was just harder than not doing it/out of my league back then. I think I'll actually give it a shot on the next phone, as I *think* the PCB can easily fit now (it's only 5x5cm, as opposed to an Arduino Uno with shield on the first prototype).
> >
> > I loved your LEGO sorter, by the way, it was very large-scale and a very interesting project, well done. I greatly enjoyed reading the writeup. Do you still use it?
> >
> > reply
> >
> > > jacquesm 1 hour ago [-]   [-]
> > >
> > > > Do you still use it?
> > >
> > > Paid work has been absolutely insane the 2nd half of 2017, we are barely managing to recover before the next all-out job is landed so unfortunately no time to mess around with other stuff. I have a few more fun projects lined up, one of which has to be ready for next summer so I will definitely be making some time for play besides more work. Can't complain though.
> > >
> > > reply
> > >
> > > > StavrosK 1 hour ago [-]   [-]
> > > >
> > > > Ah, lots of paid work is always good news. I'm looking forward to reading about your next project, it helps with my inspiration as well. Make sure you don't spend too much time working, fun is important.
> > > >
> > > > reply

mtgx 9 hours ago [-]   [-]

It's a shame the Wi-Fi Alliance is showing no interest in long-range mesh capabilities for its Wi-Fi standards.

The mesh-like standards it does have currently are mainly focused on home automation, and they only cared about developing those because Bluetooth was becoming the de-factor standard for IoT, and now 6LoWPAN seems to be taking over.

802.11ax promised 5x the range of 802.11n *in theory*, but implementers will go up to 2x, at most, likely preferring to focus on increased performance/bandwidth instead.

I think it would be really cool if we could have a Wi-Fi standard that would go through buildings over 1 mile even at 1Mbps speeds. And I think we now have the technology and know-how for how to deal with interference from similar Wi-Fi emitters.

It would be nice if something like this was made by the Wi-Fi Alliance because then we could all have that capability in our phones within 5 years after release. Think how much that would help in cases of disaster: earthquakes, tsunamis, hurricanes, wars, and so on.

reply

> ac29 7 hours ago [-]   [-]
>
> >long-range mesh capabilities for its Wi-Fi standards
>
> >go through buildings over 1 mile even at 1Mbps speeds
>
> That sounds like a nightmare. WiFi is already nearly unusuable in high density situations. A recent trip to help a friend living in a medium density part of a large city showed ~100 access points, using the lousy WiFi antenna on my smartphone. Even every single 5GHz channel (which really doesnt travel well through objects) was taken, usually twice or more, including all the DFS channels. Mind you, this was inside.
>
> I cant begin to imagine how unusable WiFi (and its related unlicenced spectrum) would become if had 5x the range. Even in low-density suburban areas, 2.4GHz is crowded to the point of degraded performance (although 5GHz is pretty clear for now).
>
> reply

> superkuh 8 hours ago [-]   [-]
>
> That's because long distance at UHF and up requires clear line of sight. And that requires at least one end of your setup being up very high on towers or buildings. Height is the reason the cell phone network works. And height is the reason mesh networks don't. Height costs money.
>
> reply

> blueprint 8 hours ago [-]   [-]
>
> > Think how much that would help in cases of disaster: earthquakes, tsunamis, hurricanes, wars, and so on.
>
> Don't forget censorship… :)
>
> reply

pingec 10 hours ago [-]   [-]

This sounds like a really fun thing to play with and could be useful for extending covered range where bandwidth requirements are low.

Where I usually struggle is making it all small and robust enough. Does anyone know of any products which integrate power supply (mains or battery) and the esp8266 into a small, cheap enclosed product. The best candidate I have found so far would be the Sonoff products.

reply

kees99 6 hours ago [-]   [-]

Battery would probably be a no-go here.

You can't put repeater into sleep mode[#], and in active AP+STA mode ESP8266 takes 70mA @3.3v, which is 3-4 times lower than best purpose-made wifi repeaters, but will still drain 3000mA*h battery in couple of days.

[#] ...unless whole sensor network has scheduled "data upload" internals, something like 1-minute window twice a day. But even that is going to be very tricky due to notoriously poor precision of ESP's real-time clock - see for example https://github.com/micropython/micropython/issues/2724

reply

conk 6 hours ago [-]   [-]

Has anyone actually tried to mesh a large number of ESP8266 chips in practice? I tried it, hooked a 7-seg display to each 8266 and started adding nodes 1 at a time. Each node would display the number of additional nodes available in the mesh (on the 7-seg). I found the mesh became unstable around 12+ nodes and would auto arrange into 2+ separate meshed networks. This was a while ago and maybe it's more stable today. I'm interested in anyone actually getting 20+ nodes working reliably.

reply

tuskan 4 hours ago [-]   [-]

This solution was limited to 8. - Due to the limitations of the ESP's SoftAP implementation, there is a maximum of 8 simultaniously connected stations. (from the README)

reply

Corrado 3 hours ago [-]   [-]

For those of you, like me, who don't know exactly what an ESP8266 is or how it might be used, check out this video by EEVBlog[0]. It gives a brief background on the chip and its alternatives and shows some simple programming examples.

[0] https://www.youtube.com/watch?v=Q6NBnPfPhWE

reply

geokon 8 hours ago [-]   [-]

It's been quite a few years since my college networking class, but am I wrong to expect this to just kinda work out of the box? The ESPs can already act as routers and the MAC/IP protocols should already insure packets get routed around correctly. How is it different from, for instance, hooking up several WiFi routers at home?

I'm curious about the challenges b/c I've been wanting to try to get a more long-distance mesh going with Lora. Some of the newer chips are incredibly affordable:

https://www.cnx-software.com/2017/10/13/this-ttgo-board-comb...

reply

feelin_googley 4 hours ago [-]   [-]

Whats up with NodeUSB? It was in Kickstarter some years ago. Anyone here have one?

It is ESP8266 and can be programmed without grahical IDE, using only GCC toolchain and Lua?

reply

vog 5 hours ago [-]   [-]

Is this interesting (or at least relevant) for the freifunk project?

reply

ferongr 7 hours ago [-]   [-]

The amount of possible chained NATs gave me an aneurysm.

reply

fulafel 9 hours ago [-]   [-]

Why v4 NAT instead of IPv6?

reply

> kees99 9 hours ago [-]   [-]
>
> Dynamic routing is the hardest part of mesh network. By using NAT *martin-ger* has side-stepped need to have routing altogether (it's just default gateway for each node like that). But that of course comes at cost - reaching your device from "outside" becomes much harder.
>
> Also, ESP8266's official SDK doesn't support IPv6.
>
> reply
>
> > abraae 8 hours ago [-]   [-]
> >
> > Could you elucidate on that? I don't get how a message is somehow routed through a thicket of say 1000 of these things to get from one node to another, because NAT?
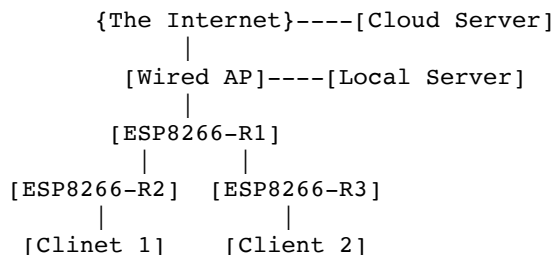> >
> > reply
> >
> > > kees99 7 hours ago [-]   [-]
> > >
> > > "Mesh" (in thick air-quotes) here is just a way for self-organizing for shortest uplink hop count.
> > >
> > > Strict uplink-downlink hierarchy still stays regardless of whether "manual uplink" or "mesh" mode is in use. Each repeater doing Source NAT still stays. Lack of "sideways" connectivity still stays (unless you configure manual DNAT which is incompatible with "mesh" mode to begin with).
> > >
> > > I.e., if you have 3 of those ESP8266 repeaters with two clients connected to different repeaters, there is no (easy) way to have those two clients talk to each other. Let's say this is our network diagram:
> > >
> > > ```
> > >         {The Internet}----[Cloud Server]
> > >                 |
> > >            [Wired AP]----[Local Server]
> > >                 |
> > >            [ESP8266-R1]
> > >              |        |
> > >        [ESP8266-R2]  [ESP8266-R3]
> > >            |              |
> > >        [Clinet 1]     [Client 2]
> > > ```
> > >
> > > ...then, we have two options how to make Client 1 and Client 2 talk to each other:

- each client talks to the same server (local or cloud) and server takes care of passing the message;

or

- we configure *static* destination NAT (option *portmap add*) on both ESP8266-R2 and ESP8266-R3, and disable "mesh" mode (i.e. manually configure uplinks for all 3 repeaters);

...and arranging 1000 of those in a single string and routing a single packet through that is better avoided. "Mesh" mode helps a lot with this, by selecting shorter path to the internet and bringing topology closer to a tree, where possible.

reply

> abraae 7 hours ago [-]   [-]
>
> Thanks! Will peruse over coffee
>
> reply

ju-st 5 hours ago [-]   [-]

Why even use routing instead of switching (bridging network interfaces)?

reply

> kees99 4 hours ago [-]   [-]
>
> L2 bridge of WiFi *access point* to anything else (like wired Ethernet, for example) "just works".
>
> On the other hand, L2 bridge of WiFi *station* to anything else (including STA<->AP bridge for a repeater operation) is quite messy: it needs special "4addr mode" packets which are only sent in "WDS" mode, which should be enabled on corresponding uplink AP. And WDS is universally disabled out-of-the box. Many cheaper routers don't have WDS at all. Plus, there are different incompatible flavours of WDS. Finally, there is question of WDS/4addr mode support on ESP8266 itself - in theory, there is *some* support in SDK, but I haven't seen any working application code doing it.
>
> Some in-depth discussion of WDS with diagrams:
>
> https://wiki.openwrt.org/doc/howto/clientmode
>
> https://www.dd-wrt.com/wiki/index.php/WDS#Note_about_WDS_and...
>
> reply

jaytaylor 7 hours ago [-]   [-]

Why can it only do about 5mbps?

reply

> kees99 7 hours ago [-]   [-]
>
> 5mbps is about the best case (all 3 nodes on the same table). In more realistic deployment, it'll be much less.
>
> So, why so slow?
>
> TL;DR: Too little RAM on ESP8266.
>
> WiFi is half-duplex, i.e. in basic scenario (no MIMO; all stations close enough that each can hear at least some other), only one node can transmit at a time. [CSMA/CA] protocol is used to enforce this limitation. This protocol is susceptible to [Hidden node problem], which absolutely will be present for wifi repeater. Meaning that data in a single burst is transmitted fast, but any switch-over of who's transmitting is going to be really slow, with collisions, pauses, etc. In turn,

that means that to achieve any decent throughput, WiFi repeater should buffer as much data as possible to minimize number of transmitter switch-overs. And that requites RAM - say to buffer half-second data burst at 54Mbps you'll need 3.5MB of RAM. Alas, ESP8266 only has 96KB of data RAM, out of which just 32KB is used as packet buffer with standard SDK.

[CSMA/CA] https://en.wikipedia.org/wiki/CSMA/CA

[Hidden node problem] https://en.wikipedia.org/wiki/Hidden_node_problem

reply

avesfan 8 hours ago [-]   [-]

Could you integrate a bitcoin address that I can pay to for bandwidth? Have the operator set the kB/satoshi and the rate at which withdrawls occur over the lightning network? When the address is empty the connection is terminated?

reply

lucaspiller 6 hours ago [-]   [-]

IUNGO is a blockchain based project to do exactly this:

https://medium.com/@iungo/iungo-global-wifi-networks-is-abou...

reply

Guidelines | FAQ | Support | API | Security | Lists | Bookmarklet | DMCA | Apply to YC | Contact

Search: [   ]