EPISODE #309

Beyond Matter: Decoding the IoT Alphabet Soup

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EPISODE SYNOPSIS

In this episode, Herman and Corn explore the complex landscape of IoT protocols, from the long-range "chirps" of LoRa to the rock-solid reliability of Z-Wave. They dismantle the myth that the new Matter standard will eliminate the need for specialized radios, explaining how the fundamental laws of physics force a trade-off between range, power, and data speed. Whether you are securing a smart home or tracking sensors across a continent, discover why the "alphabet soup" of connectivity is here to stay and how the future of the Internet of Things is moving toward software unity through hardware diversity.

DANIEL'S PROMPT

Daniel

We've discussed IoT radio networks before, and I've shared my experience using Zigbee and Home Assistant. Beyond Zigbee and Matter, there are several other standards like LoRa, NB-IoT, LoRaWAN, Z-Wave, and BLE. In both industrial and home contexts, do all of these standards still have legitimate, independent uses, or are we starting to see consolidation? What are the specific use cases and strengths of these different networks, and why might one be preferred over another—for example, why is LoRa often used for security systems instead of Zigbee?

TRANSCRIPT

Corn

Hey everyone, welcome back to My Weird Prompts. I am Corn, and I am sitting here in our living room in Jerusalem with my brother, the man who probably has more radio antennas in his bedroom than a small intelligence agency.

Herman

Herman Poppleberry, at your service. And for the record, Corn, those antennas are strictly for research purposes. Although, the neighbors have started asking why my window glows blue at three in the morning.

Corn

It is the glow of progress, Herman. Or just a very poorly shielded router. So, our housemate Daniel sent us a really interesting audio prompt today. He has been diving deep into the world of home automation, moving from basic Wi-Fi plugs to a full Home Assistant setup with Zigbee. But he is looking at the broader landscape and realizing that Zigbee and the new Matter standard are just the tip of the iceberg.

Herman

It is a massive iceberg, too. Once you look past the consumer shelves at the local hardware store, you run into this alphabet soup of protocols. LoRa, LoRaWAN, Z-Wave, Narrowband Internet of Things, Bluetooth Low Energy, LTE-M. It can feel like every company just decided to invent their own language for light bulbs and soil sensors to talk to each other.

Corn

And Daniel specifically asked if we are seeing consolidation. With Matter and Thread supposedly becoming the universal standards, do these other ones still have a reason to exist? Or are they just legacy tech waiting to be phased out? He also had a specific question about why something like LoRa is so popular for security systems compared to Zigbee.

Herman

That is such a sharp observation. It gets to the heart of why "one size fits all" almost never works in the world of physics. Because at the end of the day, these are not just software protocols. They are radio waves, and radio waves are bound by the laws of electromagnetism. You cannot just code your way out of a range problem or a battery life problem if you are using the wrong frequency.

Corn

Right, and that is where I want to start. Let us talk about the "why" behind these different standards. If I am building a smart home, I usually start with Zigbee or maybe Z-Wave. But if I am an industrial farmer or a city planner, those are probably the last things I am looking at. Why is that?

Herman

It comes down to the classic engineering trade-off triangle. You have range, power consumption, and data rate. You can usually have two, but you can almost never have all three. Zigbee and Thread, which is the backbone of Matter, live in the two point four gigahertz frequency range. That is the same neighborhood as your Wi-Fi and your microwave. It is great for sending a decent amount of data quickly, like a firmware update for a light bulb, and it uses very little power. But the range is short. It is meant for a single house where the devices can form a mesh and pass signals to each other.

Corn

And that mesh is the key, right? We talked about this a bit in episode one hundred sixty-four when we were looking at radio frequency hygiene. In a mesh, every plugged-in device acts as a repeater. But if you are in a massive warehouse or trying to monitor a vineyard, you cannot just keep plugging in repeaters every thirty feet.

Herman

Exactly. And that is where LoRa enters the room. LoRa stands for Long Range. It operates on sub-gigahertz frequencies. In the United States, that is usually around nine hundred fifteen megahertz, and in Europe, it is eight hundred sixty-eight megahertz. Lower frequencies penetrate walls and obstacles much better than the high-frequency two point four gigahertz waves. But the real magic of LoRa is the modulation. It uses something called Chirp Spread Spectrum.

Corn

That sounds like something out of a science fiction novel. What is a chirp in this context?

Herman

Think of it like a whistle that starts at a low pitch and slides up to a high pitch. By spreading the signal across a wider frequency band in that specific pattern, the receiver can pick it up even if the signal is incredibly weak or buried under a lot of background noise. We are talking about ranges of ten to fifteen kilometers in open areas. I have seen enthusiasts get a signal from a LoRa device to a gateway that was over eight hundred kilometers away by using high-altitude balloons.

Corn

Eight hundred kilometers? That is insane. But I assume the trade-off there is the data rate. You are not exactly streaming video over a chirp.

Herman

Oh, not even close. You are lucky if you can send a few dozen bytes at a time. It is perfect for saying, the gate is open, or the soil moisture is twelve percent. That is it. And that brings us to Daniel's question about security systems. Why use LoRa for security instead of Zigbee?

Corn

I would guess it is about reliability and "no-go" zones. If I have a sensor on a gate at the end of a long driveway, Zigbee is never going to reach it without a chain of repeaters that could all be points of failure.

Herman

Precisely. If one light bulb in your Zigbee mesh gets unplugged, a whole section of your security network could go dark. LoRa is a star topology, not a mesh. Every sensor talks directly to the central gateway. Because the range is so massive, you do not need repeaters. It is also much harder to jam. If a burglar brings a cheap two point four gigahertz jammer to kill your Wi-Fi and Zigbee cameras, your LoRa sensors on the windows and doors will likely keep chirping away on that lower frequency without even noticing.

Corn

That makes a lot of sense. So, in that context, LoRa is not a competitor to Zigbee. It is a specialized tool for long-range, high-reliability, low-data tasks. But what about Z-Wave? Daniel mentioned that one too. For a long time, it was the big rival to Zigbee in the home. Is it still relevant now that Matter is here?

Herman

Z-Wave is in a fascinating spot. It also uses those sub-gigahertz frequencies, like nine hundred eight megahertz in the United States. This gives it a major advantage over Zigbee in a typical home. It does not compete with your Wi-Fi for airtime, and it travels through walls much better. If you live in an old house with thick stone walls, like some of the buildings here in Jerusalem, Z-Wave is often much more stable than Zigbee.

Corn

I remember you telling me that Z-Wave has a much stricter certification process, too.

Herman

It does. For years, Z-Wave was a closed standard owned by one company, which meant every single device was guaranteed to work with every other device. Zigbee was more of an open playground, which led to some compatibility headaches. Even though Z-Wave is more open now, that legacy of stability remains. There are thousands of Z-Wave devices out there, especially in professionally installed security systems. While Matter is the shiny new thing, Z-Wave is the "Old Reliable" that just works. I do not see it disappearing anytime soon because it solves the interference problem so elegantly.

Corn

So we have the home covered with Zigbee, Thread, and Z-Wave. We have the long-range stuff covered by LoRa. But then there is the cellular side of things. Daniel mentioned NB-IoT. That stands for Narrowband Internet of Things, right? How does that fit into the mix?

Herman

This is where things get really interesting for the industrial side. Think about a smart water meter or a gas meter. It is probably buried under a metal cover in the ground or hidden in a basement. You cannot expect a homeowner to provide a Wi-Fi or Zigbee connection for a utility company's meter. And the utility company does not want to build their own network of LoRa gateways across an entire city if they do not have to.

Corn

So they use the existing cellular towers.

Herman

Exactly. Narrowband Internet of Things and its cousin, LTE-M, are protocols designed to run on the same towers that provide your phone's five-G or four-G signal. But they are optimized for sensors. They can penetrate deep into buildings and underground. The best part is the power efficiency. A water meter using Narrowband Internet of Things can run on a single battery for ten years because it spends ninety-nine percent of its time in a deep sleep mode, waking up once a day to send a tiny packet of data.

Corn

That is a completely different use case. You are essentially renting a tiny slice of a massive, pre-existing network. But I imagine there is a subscription cost associated with that, unlike LoRa where you own the gateway.

Herman

You nailed it. That is the primary decision point for a business. Do you want to pay a few dollars a year per device to a carrier like Verizon or Deutsche Telekom for a Narrowband connection? Or do you want to spend the capital up front to build your own LoRaWAN network? If you are a farmer with a thousand acres, you build your own LoRa network. If you are a shipping company tracking containers across a whole continent, you use cellular IoT.

Corn

Okay, so we are seeing a very clear map of niches here. But let us talk about the "Elephant in the Room," which is Matter. The promise of Matter was that we would stop having to care about which radio was inside our devices. You buy a thing, it has the Matter logo, and it works. Is Matter actually consolidating these radios, or is it just adding another layer of complexity?

Herman

Matter is an application layer. Think of it like the language the devices speak, while Zigbee or Thread is the radio they use to talk. Matter currently runs over three main "transports." Wi-Fi for high-power devices like TVs or plugged-in cameras, Thread for low-power mesh devices like sensors and light bulbs, and Bluetooth Low Energy for the initial setup or "commissioning" of the device.

Corn

So Matter is actually pushing the industry toward Thread and Wi-Fi, and away from things like Zigbee and Z-Wave?

Herman

In the consumer smart home space, yes. Matter version one point three, which is the current stable standard as we talk today in early twenty twenty-six, has expanded to include things like electric vehicle chargers, water leak sensors, and even large appliances like dryers and ovens. The goal is that if you are a manufacturer, you just build for Matter over Thread. But here is the catch. There are millions of existing Zigbee and Z-Wave devices. So we are seeing the rise of "bridges."

Corn

Right, like the bridges we have discussed before. You plug a box into your router that speaks Zigbee on one side and Matter on the other.

Herman

Exactly. So the consolidation is happening at the software level. Your phone or your smart hub will see everything as a "Matter device," regardless of the radio. But the physical radios are not consolidating because, again, the physics hasn't changed. Thread is great for a light bulb, but it still cannot reach a sensor two miles away. So a Matter-compatible LoRa gateway is likely the future for those long-range needs.

Corn

That is a really important distinction. The interface is consolidating, but the hardware is actually becoming more specialized. It is like how we all use the internet protocol to communicate, but some of us are on fiber optics, some are on five-G, and some are on satellite. The protocol is the same, but the delivery mechanism depends on the situation.

Herman

That is a perfect analogy. And speaking of satellite, that is one of the biggest trends we are seeing right now in twenty twenty-six. There are companies now that allow LoRaWAN devices to talk directly to low-earth orbit satellites. Imagine a sensor in the middle of the Sahara Desert or the middle of the Pacific Ocean. It chirps its little LoRa signal up into the sky, a satellite picks it up, and it lands in your dashboard. No towers, no gateways, just pure radio physics.

Corn

That is incredible. It really expands the "Internet of Things" to the "Internet of Everywhere." But let us bring it back to the home for a second. Daniel mentioned Bluetooth Low Energy, or BLE. We usually think of that for headphones or smartwatches. Does it have a real future as a primary IoT network?

Herman

For most things, no. Bluetooth is great for point-to-point communication. It is how your phone tells your new smart plug what your Wi-Fi password is. But as a network, it has historically struggled. However, there is a very cool niche called "ambient IoT" that is using Bluetooth. There are these tiny, paper-thin sensors that don't even have batteries. They harvest energy from the radio waves around them, like the Wi-Fi signals in your house, and they use that tiny bit of power to broadcast a Bluetooth signal.

Corn

Wait, no batteries at all? Just living off the "electronic smog" in the air?

Herman

Exactly. Companies like Wiliot have been pioneering this. They are basically smart stickers. You could put one on every single item in a grocery store, and the store's Bluetooth sensors would always know exactly where every box of cereal is and what the temperature of the milk is. That is a massive use case for Bluetooth that Zigbee or Thread couldn't touch because those protocols require way too much power for a battery-less sticker.

Corn

This really illustrates your point about the engineering triangle. Bluetooth Low Energy is winning the "lowest possible power" corner of the triangle for these tiny sensors. So, if we look at the landscape Daniel asked about, we have a very clear picture. Thread and Wi-Fi are winning the smart home. Z-Wave is holding onto the high-end, high-reliability home security niche. LoRa is the king of the long-range outdoor world. Cellular IoT is for the massive industrial and utility deployments. And Bluetooth is carving out this weird, cool space in ambient, battery-less sensors.

Herman

It is a beautiful ecosystem when you look at it that way. It is not a war where one standard has to kill the others. It is an evolution where each standard is finding the specific environment where it thrives. The real progress isn't in finding one radio to rule them all. It is in the work being done by the Connectivity Standards Alliance and others to make sure that even if the radios are different, the data they send can be understood by everything else.

Corn

So, for someone like Daniel, the advice is basically to choose the radio that fits the physical environment. If you are in a small apartment, Zigbee or Thread is perfect. If you are in a house with thick walls and you are worried about interference, Z-Wave might be worth the extra cost. And if you are trying to monitor your mailbox that is at the end of a long driveway, do not even try to make a mesh reach that far. Just get a LoRa gateway.

Herman

Spot on. And for the really nerdy listeners, I would say keep an eye on the transition from Zigbee to Thread. Since they both use the same physical radio chips in many cases, we are seeing a lot of older Zigbee devices getting firmware updates to support Thread and Matter. That is the closest thing to "consolidation" we are going to get in the short term.

Corn

I actually wanted to ask you about that. We have seen some movement in the open-source community, specifically with projects like Home Assistant, making it easier to manage these "multi-protocol" networks. In the past, you needed a separate dongle for everything. Now, we are seeing these universal radios that can handle Zigbee and Thread simultaneously.

Herman

Yes, the "Yellow" and "SkyConnect" style hardware. It is a big step forward. But as we discussed in episode three hundred when we were talking about Trusted Platform Modules, the security side of these multi-protocol radios is tricky. You are essentially running two different networks on the same piece of silicon. If one has a vulnerability, does it compromise the other? It is a fascinating area of research right now.

Corn

It always comes back to security with you, Herman. But that is why we love you. So, to wrap up the "consolidation" question, the answer is a "yes" on the software side and a "no" on the hardware side. And that is actually a good thing for consumers. We want the best radio for the job, but we want the convenience of a single app.

Herman

Exactly. We want the diversity of the biological world but with a universal translator. And we are closer to that today in twenty twenty-six than we have ever been. Matter might have had a rocky start a few years ago, but version one point three has really stabilized things. The fact that I can buy a Z-Wave lock, a Thread light bulb, and a Wi-Fi camera and have them all talk to each other through a single Matter bridge is a huge win.

Corn

It really is. I remember the days of having seven different hubs plugged into a power strip under my desk just to make my house feel "smart." We are finally moving past that. So, what is the one takeaway for our listeners who are looking at their own setups?

Herman

I would say, do not be afraid of the variety. If you see a device that uses a "weird" radio like LoRa or Z-Wave, do not dismiss it just because it is not Matter-native yet. Look at the problem you are trying to solve. If you need range or reliability through walls, those "old" standards are often still superior. Just make sure you have a good way to bridge them into your main system. Home Assistant is still the gold standard for that, in my opinion.

Corn

I agree. It is the glue that holds all these different radio frequencies together. Well, this has been a great deep dive. I feel like I understand the "why" behind my own smart home glitches a bit better now. It is probably just the two point four gigahertz band being a crowded mess.

Herman

It almost always is, Corn. It almost always is. If your light bulbs are acting up, maybe stop running the microwave so much.

Corn

I will take that under advisement. Before we sign off, I want to say a huge thank you to Daniel for sending in this prompt. It is exactly the kind of technical rabbit hole we love to fall down. And to our listeners, if you are enjoying these deep dives into the guts of our digital world, we would really appreciate it if you could leave us a review on Spotify or whatever podcast app you are using. It actually helps a lot in helping other curious people find the show.

Herman

It really does. We read all of them, even the ones that tell me I talk too much about radio modulation. Which, to be fair, is a valid critique.

Corn

We love it, Herman. Don't change. You can find all our past episodes and a contact form at our website, myweirdprompts.com. We are also on Spotify, obviously. If you have a question that is keeping you up at night, send it our way. We might just spend half an hour talking about it.

Herman

Or forty-five minutes if it involves antennas.

Corn

Fair point. This has been My Weird Prompts. I am Corn.

Herman

And I am Herman Poppleberry.

Corn

We will see you next time. Stay curious.

Herman

And keep your signals clear.

Corn

So, Herman, be honest. How many LoRa gateways do you actually have in the house right now?

Herman

Only three, Corn. But one of them is experimental and it is currently trying to ping a weather balloon over the Mediterranean.

Corn

Of course it is. I am going to go make some coffee. I hope the microwave doesn't kill your connection.

Herman

It is okay, the balloon is on the eight hundred sixty-eight megahertz band. Your caffeine addiction is safe from my research for now.

Corn

Good to know. Talk to you later, brother.

Herman

Later, Corn.

Corn

And thanks again to everyone for listening. We really do value the community we have built here. It is amazing to see how many people are as interested in the "how things work" side of life as we are.

Herman

It makes the late nights of reading white papers totally worth it. Alright, signing off for real now.

Corn

Goodbye everyone!

Herman

Bye!