



Episode 407 - Arun Kumar - W8ARU

Commissioned by: Mike Tindor AA8IA

Eric 4Z1UG:

QSO Today, episode 407, Arun Kumar W8ARU.

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Welcome to the QSO Today Podcast. I'm Eric Guth, amateur call sign 4Z1UG, where I demonstrate the diversity and relevance of the amateur radio hobby and its impact on society. By interviewing ham radio operators, many of whom played vital roles in shaping our technology through the amateur radio hobby. And while many people might say, ham radio, do people still do that? This podcast demonstrates through in-depth interviews, just how amazing, diverse and dynamic the amateur radio hobby continues to be. I am attempting to clean up the QSO Today mailing list to reduce its monthly costs, but also to be sure that only the people that want emails from QSO Today are getting them. I'm sensitive to people who complain that their E-inbox is never under control.

Eric 4Z1UG:

If you see my message, please use the form to resubscribe to my messages or unsubscribe if you don't want an email from me. Either way, this will benefit us all. If you want to be on the email list, because you're not on the list to hear about the podcast, the expo, and soon the academy, please use the subscribe button on the bottom of the show notes page. Arun Kumar W8ARU builds most of the gear that he uses on the air base on a skill-set that he learned and became an amateur radio operator in India in the 1960s. This skill-set combined with advanced degrees in engineering has put Arun on the cutting edge of solar and battery technologies used in big equipment as the world is going green. Arun was also Ashhar Farhan, VU2ESE's original mentor, one of the many major contributions that Arun has made to our hobby. W8ARU is my QSO Today.

W8ARU, this is Eric 4Z1UG. Are you there Arun?

Arun W8ARU:

Yes, I am, Eric. How are you?

Eric 4Z1UG:

I am great. Arun, thanks for joining me on the QSO Today Podcast. I have to let everyone know that you and I met at the FDIM Dayton Hamvention this last month, a month ago, because you were Ashhar Farhan's VU2ESEs companion or sidekick, or he was your sidekick. But anyway, the opportunity to meet you was my great pleasure. And a friend of Ashhar's is a friend of mine. So I'm so delighted that you agreed to join me on the QSO Today Podcast. Can we start at the beginning of your ham radio story, when and how did it start for you?

Arun W8ARU:

Sure. I was interested in broadcast receivers and just generally electronics ever since, maybe about 1955 when I had my hands into my father's old farms with tube radio. And I kept listening to stuff which was generally ham-related, but I could never make too much sense out of it because my receiver was not good. But anyway, I built stuff around it. I built a BFO around that radio, and pretty soon I was listening to CW conversations. And for the life of me, I couldn't make any sense out of it because I knew no CW.

Arun W8ARU:

And then, eventually, in around '68, I believe it was, I got my ham radio license. This was when I had just joined college in the city called Ranchi in India. And there was another ham who had just joined a year prior. And he said, "Why don't you come over and sit for the license exam and then you can get your ticket?" So we went over to Kolkata, a great city on the east coast in India, and I sat for the license exam and I said, I'm going to do 12 words a minute, nothing short, because we had either a five word a minute, which was equal to the technician class here. And the 12 words a minute, which was the advanced class. So I sat for the 12 words a minute test. And I got my license around 1968, I believe it was.

Eric 4Z1UG:

You started to develop the interest in electronics and electricity from having this radio, or did that interest develop even earlier when you were a kid?

Arun W8ARU:

Well, it was much earlier. I used to fool around with anything, which clocks were my favorites. I used to take clocks apart.

Eric 4Z1UG:

Mechanical clocks?

Arun W8ARU:

Yes, mechanical clocks. That was the only type that was available then. But I could always take a clock apart and never make it tick. So eventually, I did. Eventually, I did. In fact, we made a few clocks out of pieces of wood and I filed the gears and it was quite a lot of fun when I was in school, but that's all I could do.

Eric 4Z1UG:

We know each other. And so I know that you're originally from India, but what was the hometown in India?

Arun W8ARU:

It was in a city called Jamshedpur, which is in the east coast. And it used to be in the state called Bihar. And there was a huge steel company there. And my father used to work there. So I did my schooling there. And then after schooling, I joined college in the state of Bihar. Yeah, it was Jamshedpur. It's the biggest steel town. It's one of the biggest steel manufacturing facilities in India, even today.

Eric 4Z1UG:

So India was moving very quickly towards heavy industrialization, high technology in those days?

Arun W8ARU:

All my schooling was in a Jesuit school in Jamshedpur by the name of Loyola High School. There, most of my interest in physics came from a professor there or a Jesuit priest by the name of Father Kirsch. And he taught me just about everything I knew at that time about electronics and electricity and general hands-on fooling around type activities.

Eric 4Z1UG:

Now, you say that you developed this interest in amateur radio in 1968. Did you know other amateur radio operators in the area where you were?

Arun W8ARU:

No. In my area, there was none.

Eric 4Z1UG:

Really?

Arun W8ARU:

Absolutely none. Jamshedpur city, there was none. Then I did my engineering in a college, in a city called Ranchi. There was none, there was no amateur radio operators there. Then finally, a guy whose call sign was VU2ZZ. He joined. And then he said, "Would you like to

take a test because you seem to be so interested in amateur radio?" I said, sure. And that's when it all started. And that's when I got my ticket in 1968.

Eric 4Z1UG:

What information was there? I mean, obviously this is pre-internet, right? So you could go to the library and probably check out books on amateur radio. But what information did you have on amateur radio in those days?

Arun W8ARU:

If I remember right, the first book on amateur radio I saw was in my college library school, the library had nothing. It had nothing on amateur radio, but in the college library, there was a 1954 edition of the ARRL handbook. And that was the only book on amateur radio I ever saw. And that was absolutely fascinating. I read that from cover to cover, at least a dozen times.

Eric 4Z1UG:

You started in this college degree in electronic engineering, did you have an opportunity to choose a direction in electronics that you wanted to emphasize?

Arun W8ARU:

Yeah, it was a standard five year course and there were fixed subjects. There was communication theory. There was digital electronics, what they call digital electronics. There was a little on microwaves. There was a lot on microwaves, actually. And then mostly it was concentrated on electrical engineering, electrical heavy machinery, design of generators, motors, transformers, and power distribution equipment. And other than that, since I got my ticket, I started working on building my own radio, building my own transmitter at that time.

Eric 4Z1UG:

What was the first receiver then that you used for amateur radio?

Arun W8ARU:

That was a Farnsworth five tube radio with an external BFO whatever I had at home.

Eric 4Z1UG:

So you kept the Farnsworth five tube?

Arun W8ARU:

Yes.

Eric 4Z1UG:

And that was like a five tube superhet broadcast radio or it was a general coverage radio?

Arun W8ARU:

It was a broadcast, it was general coverage in the sense that it went to 15 meters with great difficulty. 21 megahertz was tops, I think. Yeah, it was a 13 meter behind it would go and touch it, nothing beyond that. It was a small dinky little affair, roughly about a foot wide, about eight inches high, and about six to eight inches deep. And it would cook. It would get hot like heck and it would drift all over the place. And the fun part is the tuning knob was very coarse. So I got a hold of some gears from a toy, some toys, which I had, the wind-up toys and with a threaded rode, I made myself a worm and worm wheel reduction. And the whole thing rested if I remember right on my dad's old license plate. It was all bolted onto that and the receiver was behind it. And I somehow managed to use that for fine tuning this receiver. It was fun. All I had to do was tap the table and frequency would go off by a 100 kilowatts, I guess. It was fun.

Eric 4Z1UG:

What was the first transmitter?

Arun W8ARU:

The first transmitter I built was, the oscillator, was, it was a CW transmitter. It had an EL84 Oscillator, EL84 doubler, and a single 807 tube, which I got from one of the guys whom I met in a city called Bangalore, which you must be familiar with. And he's still alive. He's still, he's still a ham. He doesn't live in Bangalore. He lives in a coffee plantation off Bangalore. His call sign is VU2TS. A guy by the name of Ganesh. And I was floating around Bangalore, because we used to go there on holidays. My grandfather used to live in Bangalore. So every summer holidays I'd land up there and then ask questions about radio and this and that, till everybody got tired of me. Then, finally one of my uncles said, "Hey, why don't you go up the street about four miles north. And you'd find this guy with a lot of wires sticking out of his house." So I did that. And it turned out that this fellow's name was Ganesh.

Eric 4Z1UG:

Well, it just so happens, Arun, that I interviewed Ganesh in episode 272. Would you say he was your first ham radio Elmer?

Arun W8ARU:

He had a transmitter at home, yes. And that way he was an Elmer because he let me use it.

Eric 4Z1UG:

It's great. I think Ganesh is still around, so.

Arun W8ARU:

He is there. He is there. I talked to him a few months back, not on the radio. I talked to him on the phone, but he's definitely around.

Eric 4Z1UG:

What was the availability of parts? I mean, where did you find parts for the projects that you were doing?

Arun W8ARU:

Zip, Z-I-P, zip. Nothing was available at that time. He had 2807 tubes. He said, "I can sell you one." I said, sure. I'll buy one. Then I said, what do I do for a base? He said, "Well, that's going to be your problem." So I made a base for that using a telescoping antenna tube, cut that tube up into segments and shoved it into the pins. Because an 807 has got two thick filament pins and a bunch of thin, I think it was one, two, three, four, five. It was a seven pin tube, if I remember right. And it had a plate cap. So a piece of brass folded around with a bolt across it, was my contact for the plate. And I didn't have a transformer to get the 750 volts, which just needed. So what I did was I took 250 volts, which is coming from the AC line and doubled it.

Arun W8ARU:

And I got about 500 volts. The only catch there is that if I reversed my power plug at any time, I would go up in smoke because it would make everything light.

Arun W8ARU:

It would either hurt me or it would blow all the fuses in the house. So I used to run around with one of these neon bulb testers in my pocket. So you keep touching everything to make sure that the chassis is not alive. So that's how I got started. And an EL84 was a standard output tube. It was an audio output tube. I don't know whether there's a US equivalent for that. There must be, but it's a glass tube about two centimeters in diameter, and about eight centimeters long, nine-pin.

Arun W8ARU:

Yes, it was a nine-pin tube. And that was a seven-mega oscillator followed by a second EL84, which was a doubler to 14. And the 807 was at 14, a regular linear. I wound all the coils, got capacitors from regular broadcast capacitors, ripped every other plate out to make it slightly higher voltage. And the thing worked and the very first contact I remember I got was JA1DJ. Yeah, that was the very first contact I had. Yes. Japan alpha, one, Delta, Japan, Japan, and that was on CW. And the first time I keyed that transmitter, this contact showed up. So I was absolutely thrilled.

Eric 4Z1UG:

What were the bands like in India with your rig in those days?

Arun W8ARU:

I didn't have much of a choice. I could either operate seven megahertz or 14 megahertz. It's 40 or 20 meters. And 20, I would prefer because there was a sizeable amount of Russian CW traffic on 20. And most of my contacts were made on 20 meters. And since I was running only CW, I had a CW transmitter. That's it. So I wasn't making any more... I mean, I couldn't talk, I couldn't do anything else. And at seven megahertz, there was a lot of noise. So I would be able to receive a few signals, a few Indian signals on seven. 14, I had a few Indian contacts and a bunch of Russian contacts, dozens of Japanese contacts, and occasionally a few US contacts. And a bunch of 4X4s. And then, there was a bunch of South African contacts, which I had.

Eric 4Z1UG:

Yeah. So the 4X4s you refer to are the Israelis?

Arun W8ARU:

Yes, yes.

Eric 4Z1UG:

I guess we're now 4X1s and 4X5s as well as 4X4s

Arun W8ARU:

Well, at that time, I think there was only 4X4.

Eric 4Z1UG:

That's very possible. What happened after that? You got this bachelor's degree, this ham radio license, how did this all proceed? You went for a higher degree?

Arun W8ARU:

Yes. I went for a master's, but by the time I went for my master's, I got called in to work for the Ministry of Defense. So they sponsored my master's degree. That was in a college in a city called Kharagpur, which is very close to Kolkata. And that was in one of the most premier institutions in India called the Indian Institute of Technology. And I didn't have a rig. I didn't have nothing. They had an old radio club there. The call sign was VU2QQ. I mean, they used to call themselves quack, quack, because they didn't do diddly. They'd sit and quack outside the room, I suppose. They had no transmit. They had an old AR88 receiver, which I souped up and I did all kinds of fun stuff with it. And then I built my own transmitter there for them.

Arun W8ARU:

That was again, 14 megahertz, only 14 megahertz CW, but there was a much, much more availability parts. The reason for that is there used to be a second World War air base, very close to this college. If you remember, there was a movie some years back called Merrill's Marauders, and that was about the Burma operation. When the US landed a bunch of troops in Burma to get it out of Japanese occupation, that air base was just next to the college. And I had full reign of that, the equipment which was in the air base. Of course, most of it was destroyed and beyond repair. I could salvage only a few large power supplies from there, a few over chassis, which I hastily converted into 807 amplifiers, and I got my station going.

Eric 4Z1UG:

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Eric 4Z1UG:

Features include RF direct sampling, 15 discrete band pass filters, large 4.3 inch color touch screen, real time spectrum scope, and an SD memory card slot. Just know that you'll

be very pleased with one of these fine rigs to enhance your contest DX and general ham radio operation in your station. Be sure to check out these Icom rigs and their full line of base stations and portable radios at an amateur radio dealer near you. And when you make that purchase of a fine Icom rig, be sure to tell your dealer that you heard about it here on the QSO Today Podcast. And now back to our QSO Today. You also developed some skills in terms of fabricating mechanical parts as well.

Arun W8ARU:

Yeah. I used to do a lot of sheet metal work because we had ready-made chassis from old radios and whatever was lying in that placed at the air base. And I took all the parts apart and then designed the whole layout, such that I could build my transmitter on it. And I do have some photographs of some of the transmitters, which I built for the Oscar work, which I will send you. Those are totally haywire. They start from one end of the table and go to the other end of the table. But I did get through Oscar six consistently for quite a while. So the thing worked.

Eric 4Z1UG:

So what happened after that? How did your ham radio life proceed? How did your professional life proceed?

Arun W8ARU:

So '72 to '74, I was in this master's program that was in microwave and radar engineering, and I did a sizeable amount of work on what is commonly referred to as phase data radar right now, which is ubiquitous. I mean, just about everything is a phase data radar, whether it's your cell phone or it's 5G or whatever it is. So I worked a lot on that with the military applications. And then I graduated to work with the Ministry of Defense in the city called Hyderabad. That's where Farhan is from actually, and that's how I got to meet him. So I worked there in their establishment on microwave receivers, microwave transmitters, transponders, and very ruggedized electronic equipment, which could take a sizeable amount of shock and beating. So that's about all I can tell you about my professional life in Hyderabad. Well, in the initial portion, then, as far as ham radio is concerned, in Karpur itself, with this Oscar six transmitter, 145.95 megahertz to be exact.

Arun W8ARU:

And there was crystal control and we didn't have crystals. The only crystal I had was a 7.9 megahertz crystal from some scrap. It was an FT-243 crystal, which I etched up to 8.10833 megahertz. That was a lot of fun. I'd take the crystal apart from the holder, hold it in a pair of plastic tweezers, dip it into hydrofluoric acid, which I got from a department, which was doing glass work because hydrofluoric acid is used for etching glass.

Arun W8ARU:

I thought it would work on quartz and it did. You stick it inside, shake it around for 15 minutes, take it out, wash it, dry it, check the frequency. And I did that for a week and I got up to the 8.108333 megahertz. We had the frequency counters in my college lab. So I was lucky. I was able to start off with 8.10833, triple it, triple it again, triple it the third time. Triple it, triple it, and then double it to get to 145.95. And it worked, seven element yagi, which we fabricated from pieces of pipe. I'll send you a photograph of that, you'll find that quite interesting.

Eric 4Z1UG:

You guys were able to build stuff, get it on the air with metal washers, whatever it is that you could find, you were able to turn that into radio stuff. And that's what's so amazing. Ashhar Farhan's quite a bit younger than you are.

Arun W8ARU:

Yes.

Eric 4Z1UG:

When you met him, was he a young kid getting interested into radio? And were you involved in that process at all?

Arun W8ARU:

I'll tell you what exactly happened. Once I left the Ministry of Defense, I started working with my own computer company. We used to make eight-bit computers, CPM-based computers. Then we used to make PCs and we sold a lot of PCs. We sold a lot of eight-bit micro-controller-based computers, all CPM or MPM or Unix-based. We built all those in a location. And at that time I hired Farhan. He just showed up at my door and he said, "Look, I'm interested in electronics, and I'm also interested in ham radio." I said, oh, my God. We got somebody who I can work with.

Arun W8ARU:

I put him through the ropes in the company. He did a lot of fabrication work for us. He did a lot of circuit design work for us. And then on the side we did some ham radio stuff, either from my house or from his place. And we built a few rigs. The first sidebar rig I built was, again, taking a bunch of crystals and trying to make a crystal filter out of it. And it was successful. I was able to work on sidebar for quite a few years, actually. And of course, CW was my mainstay. He was involved. In fact, all his initial, starting from drilling, soldering, chassis fabrications, circuit design, and whatever, was done when he was working with me.

Eric 4Z1UG:

I sometimes think that the problem we have in ham radio is that the availability of everything is so immediate now that the fact that you don't have to scrape for stuff means that you don't necessarily develop the skill sets-

Arun W8ARU:

Absolutely.

Eric 4Z1UG:

... that make you a great engineer.

Arun W8ARU:

Absolutely. Absolutely. I still haven't gotten into that habit of just going out and buying things, plugging it in, connecting an antenna and running it. I insist on building everything.

Eric 4Z1UG:

So most of your gear is home brew?

Arun W8ARU:

Most of my gear, the mainstay here is a K3 transceiver, but my VHF transmitter, VHF receiver, antenna, satellite tracking antenna, all that stuff is built at home.

Eric 4Z1UG:

This tracking system. This is because you have an interest in AMSAT satellites. And so the latest one, you track the latest ones or whatever happens to be flowing?

Arun W8ARU:

I can track, any whatever is going on I can track a bunch using SAT PC-32, this thing merely follows whatever satellite is available at the given time.

Eric 4Z1UG:

So PC-32 is a software program that aims the antenna?

Arun W8ARU:

Yes, it's SAT PC-32; sugar, alpha, tango, papa, Charlie, 32. It's a standard program, which is, I think it was written in Germany. And you just give it the coordinates of your particular satellite or what they call the TLES, the two line element set, and then pick up the appropriate satellite from a bunch. And then it follows, it tracks it. Then you can even use it to Doppler shift your receiver, but all those fancy things I don't use, I just use it to track the antenna. That way you get, instead of occasional contact, you can get a continuous contact for the duration of the pass.

Eric 4Z1UG:

What mode do you operate when you're doing satellite contacts?

Arun W8ARU:

I have done all of them. Digital, FM, as well as CW, but I prefer CW. It's more fun. I still run CW.

Eric 4Z1UG:

Yeah, because I would think that CW on a satellite pass is like doing a contest, right? Or trying to get the contest station before he disappears.

Arun W8ARU:

Exactly. You have six minutes normally on the best pass from horizon to horizon.

Eric 4Z1UG:

Are you in a place in Michigan that gives you the ability to see the horizon on both sides?

Arun W8ARU:

Yes, yes.

Eric 4Z1UG:

So you're on a hill.

Arun W8ARU:

No. No, not really. Michigan is flat line, so wherever you are. You're not very high.

Eric 4Z1UG:

I see.

Arun W8ARU:

But it is quite forgiving. Even if you pointed generally horizontal, you do get pretty close to the horizon.

Eric 4Z1UG:

Okay. Well, the fact now is that you are in Michigan and you're an entrepreneur and you've had a couple of businesses. You have a business now, how did you find your way to Michigan?

Arun W8ARU:

See, in 1991, I told you, there was this guy by the name of Stan Oshinsky, who was paying a visit to India, to a company, which I was consulting for. Then he said, "That would be a good idea for you to come over and pay us a visit." So I visited him in '91. This was a factory in Troy, Troy, Michigan. And he offered me a job. So he said, "Why don't you come over and work for us?" So before I knew what was happening within a week, I got my, what they call the H1B visa. And he said, "Why don't you go back to India, bring your family over." Sure. And that's when we moved to the US.

Arun W8ARU:

So I worked with him on the solar business for... I was in the solar division. I worked with him for 30 years, nearly till the company went under around 2012, because of very intense competition from a Chinese solar manufacturer. We were the first people to make what they call Amorphous silicon multi-junction cells for converting sunlight into electricity. And we had, I think, the final tally was 40 gigawatts of panels installed worldwide. So that's how I got into Michigan.

Eric 4Z1UG:

Do you have some patents, I think?

Arun W8ARU:

Yes. I have patents on instrumentation for measuring and improving performance of these amorphous cells.

Eric 4Z1UG:

Do you think the United States has the raw materials and resources to actually start building their own solar panels?

Arun W8ARU:

Well, we used to. We still do, but it's a bit more expensive. It's cheaper to buy panels from, let's say, Hong Kong or China at the present time

Eric 4Z1UG:

At the present time. And that's only because their labor costs-

Arun W8ARU:

And it's very highly subsidized there. Well, they set up their groundwork many years prior. You see to manufacture a Crystalline silicon cell you need to grow Crystalline silicon. And that process takes quite a few years from start to production. You have to melt a bunch of silicon and pull crystals out of it. And by the time you get few Crystalline silicon, it's a few years and all these foundries are started in China so many years back. And right now

they've got tons and tons of Crystalline silicon. I mean, some mechanical grade crystalline silicon available for the solar market.

Eric 4Z1UG:

Oh, so that's very interesting. So in order for America to establish a competitive solar panel industry, then it would actually have to start laying those foundations now even to be able to have some production output a few years from now.

Arun W8ARU:

Well, they already do. There is quite a few places, but they have other technologies. Crystalline silicon is not the only answer. Cadmium telluride is another, which is made by a company in Ohio by the name of First Solar. And they make excellent cells, very high efficiency cells. And they sell quite a lot. But cadmium and tellurium, they're toxic material. So there's a problem with disposal and what have you, but Crystalline silicon, mono-crystalline, poly-crystalline silicon, the amount which is made in the US is not even close to what China produces at the present time.

Eric 4Z1UG:

That's an interesting stray because I think we're all talking about renewable energy right now, as a way to generate at least some of the electricity that we use. But it seems to me that the issues of raw materials, the availability of raw materials, getting those raw materials to the manufacturing sites, it seems like those are also challenges.

Arun W8ARU:

They are. Yes, yes. To make it cost effective, it's not all... Well, it's more expensive making it in the US at the present time.

Eric 4Z1UG:

I want take a minute to tell you about my favorite podcast, the Ham Radio Workbench Podcast with George KJ6VU and now joined by Rod VA3ON, Mike VA3MW, Mark N6MTS and Vince VE6LK. Every two weeks, George and company offer up a status report on the mini amateur radio projects on their work benches and explore projects on their guest work benches. This group is project active and prolific, covering many technical areas of amateur radio. So the next time you want a deep dive into ham radio electronic project building, or to learn about technology, tools, test equipment, construction techniques, and the rest, listen to the Ham Radio Workbench Podcast available on every podcast player and channel. Use the link in this week's show notes page to get to the Ham Radio Workbench Podcast directly. And now back to my QSO. Your favorite operating mode is CW, but it also seems to me, at least from what I could tell is that you also like to do contests. You enter a contest?

Arun W8ARU:

Yes. In fact, next weekend there is this, it is our field day and I'll be operating CW. I think next Saturday afternoon through Sunday, well, lunchtime at least.

Eric 4Z1UG:

Yeah. It rents about 24 hours, right? Or slightly less. Do you belong to an amateur radio club?

Arun W8ARU:

Yes. Yeah, the local club here is the Arrow Communication Club or the Arrow Club in Ann Arbor. You may have met, or you may have talked to KB6NU.

Eric 4Z1UG:

Sure.

Arun W8ARU:

Dan. Yep, ye p. He is a stalwart here as far as CW and the Arrow Club and club activities are concerned.

Eric 4Z1UG:

Well, Dan was also a guest of the QSO Today Podcast, so.

Arun W8ARU:

Yeah, I think so. Yeah, I did see one of-

Eric 4Z1UG:

I'll put a link to his interview in the show notes page as well. We're seeing Dan now he works for ARDC as their public relations guy.

Arun W8ARU:

Right, right.

Eric 4Z1UG:

He's probably a very well, as you are, a very well known ham in Ann Arbor.

Arun W8ARU:

I'm not very well known because I keep to myself most of the time.

Eric 4Z1UG:

You're going to be very well known after this podcast.

Arun W8ARU:

Maybe. Yes.

Eric 4Z1UG:

And do you take a leadership position in your club?

Arun W8ARU:

Not really. I've not been keeping excellent health that's why I avoid my... First of all, we haven't had a regular meeting in, I think, as long as two years. Most of them have been on the air. I mean, it's been on Zoom and unfortunately my morning place of work is about 60, 65 miles from where I live. So I am not able to make those meetings, but once they start meeting in person, I think, I will start joining them again.

Eric 4Z1UG:

Now, you have your own business now, what is that business?

Arun W8ARU:

We make battery packs, lithium battery packs for things like forklift trucks for electric buses, trucks, heavy duty vehicles. We don't get into the regular general automotive space, which is cars and things like that. Electric cars we don't do, but we do motive, but non-automotive, that is forklifts.

Eric 4Z1UG:

Right, but these are big batteries.

Arun W8ARU:

Yes. These are big packs. These are 48-volt packs all the way to 700-volt.

Eric 4Z1UG:

If you don't mind saying what's under the hood of one of these batteries. I heard that someone said it in a Tesla battery, that there's a bunch of these little, 1.5 volt or three volt cells all packed together. If we opened up one of these battery packs, would we find hundreds of these cells all bonded together?

Arun W8ARU:

Yes. The work cars is something called an 18650, which is a lithium ion battery, which is 16 millimeters in diameter and 85 millimeters long. That's why it's called a 1650. And these normally run 3.7 volts. Minimum is 2.7, maximum is 4.2 fully charged. 3.7 is their sweet running spot. So there are thousands of these in series and parallel to get to 350 volts.

Eric 4Z1UG:

Really? Wow.

Arun W8ARU:

Yeah.

Eric 4Z1UG:

So you take them by the truckload.

Arun W8ARU:

We buy them by the truckload, yes.

Eric 4Z1UG:

Do these batteries also have then charging circuits or circuits to manage them?

Arun W8ARU:

Yes. Yes, exactly. These do need to be run very carefully. If the temperature goes above 55 degrees centigrade, you're going to lose the battery in either a total thermal runaway, or it'll be impossible to charge them once they get that hot because they'll get only hotter when you charge them. And once again, if it's very cold, if it's below minus 17 centigrade, it's difficult. It's impossible to get any power from that. So you got to have some sort of a scheme to monitor the voltage and the temperature of each parallel pack. There are so many cells in one parallel pack or what they call a module. And those are connected in series to get to 350 volts or 700 volts. So whatever it is that your vehicle runs at. So you got to monitor these things very carefully in the running condition and monitor how much residual charge is left.

Arun W8ARU:

So you can indicate when would be a good time to recharge these batteries. And while you recharge it, if the individual parallel stacks are at different states of charge, you've got to make sure that you do not put too much voltage across cells which are weaker. If you do that, you are liable to blow the place up. So you got to do what they call balancing, cell balancing, passive or active cell balancing, and all that is handled by the battery management system. And every one of these packs has one. And the BMS also communicates to the rest of the wake up, the engine controller and things like that, or your dashboard to make sure that you extract maximum power from the pack, maximum energy from the pack and make sure that you bring it to a condition such that it doesn't go below a 10 or a 15% state of charge. Otherwise, if you go below 2.7 watts, you have just a lump of lithium under your hood and national hood.

Eric 4Z1UG:

Seems to me that 55 degrees C is pretty hot, but there could be parts of the world where you might have poor performance because it's so hot if you were out in the Saudi desert or.

Arun W8ARU:

Yes. So what you do is you have a cooling system, which is connected to each one of these cells somehow. I mean, there are different ways of doing it, but the most common way is to put it on an aluminum platform and push refrigerated liquid through it so that the temperature does not exceed 55 degrees centigrade or 50 degrees centigrade. And once it gets to too lower temperature, then you push hot fluid through the cooling plates so that the battery warms up before you do everything with it.

Eric 4Z1UG:

So there's a whole environmental control system around the batteries. Is this true with a Tesla battery?

Arun W8ARU:

Yes, yes, yes, yes, yes. You should seize some of the YouTube videos on people who have taken apart their Tesla packs or any pack for that matter. And it is phenomenally complicated.

Eric 4Z1UG:

And when the system doesn't work, that's when we see those spectacular videos on YouTube of a Tesla car burning to the ground.

Arun W8ARU:

Most of them are usually nothing to do with Tesla.

Eric 4Z1UG:

Well, it just so happens they always catch them with their phones out in the field.

Arun W8ARU:

That's right.

Eric 4Z1UG:

Right, it doesn't have to be Tesla necessary, but it happens to be a spectacular battery meltdown.

Arun W8ARU:

We have test facilities for these packs and I have seen my share of spectacular events.

Eric 4Z1UG:

How do we dispose of these in the future? Or can we recycle, can lithium batteries be recycled in order to make new battery packs?

Arun W8ARU:

Yes. There are people who are doing that right now. They are removing the outside, the nickel content, and then recycling the lithium, which is inside there. But that's much slower than what... See, the thing is lithium is a very small percentage of what goes into the pack. Most of it is other materials, carbon, nickel, plastic. Taking all that apart is... You see, the thing is, lithium, an 18650 is made like a capacitor, like an electrolytic capacitor. It's an anode and a cathode with a separator in between, which is wrapped around on itself and shoved into a can. So it's quite a nuisance taking it apart, but people have managed to do that. And there is quite a thriving business right now in getting these cells recycled into their constituent metals.

Eric 4Z1UG:

Right. I mean, I see this as an opportunity for an entrepreneur to, or entrepreneurs, to be able, as we become more dependent on electric vehicles and other battery operated devices to recycle these batteries, perhaps in country, because the cost of then shipping in both directions, wherever you end up doing it-

Arun W8ARU:

It's not worth it.

Eric 4Z1UG:

It's not worth it, right.

Arun W8ARU:

There's another thing which you can do, which quite a few people are doing. That's what they call second-life batteries, which is basically if a battery cannot run an electric vehicle, it could run something like a standby power supply. A stationary power supply, because the way the, first of all, the utilization of a standby power supply is hardly two, 3% of the time. And maybe for a very short duration, maybe for a few minutes or a half an hour at the most, where the main supply goes off. And then the battery kicks in through an inverter. For that you can use batteries, which have come out of vehicles because you're keeping it fully charged all the time and depleting it to maybe about a few percent or maybe 10% at the most. And that way you can get another five, six years out of a used vehicle pack. After that, you can think of recycling the material.

Eric 4Z1UG:

That seems like also a very interesting opportunity.

Arun W8ARU:

Well, there's quite a few people who do that.

Eric 4Z1UG:

If a larger percentage of the power grid becomes based on renewable energy. And I think we know, although we probably don't want to admit it, that renewable energy, it tends to fluctuate in its availability based on the availability of sun and wind and stuff that it seems like this idea then of creating perhaps a whole house voltage regulator for all intents and purposes out of these second-life batteries. I mean, it seems to me that you could actually create a solution hand-in-hand, knowing that you may have a problem with 10, 20, 30% of your generation coming from renewables. But you can solve the brown out problem with a whole house battery backup.

Arun W8ARU:

Yes, yes, yes. In fact, it started quite a few years back when a heck of a lot of batteries came out of the lead acid, the car and truck businesses. There's quite a few companies, but unfortunately they're not as many as they should be, who utilize these batteries for their second life. So I think that's an area that lots of people can get into. And that's a lot of fun. It's electronics for static starters, and it's a management, battery management, because then what you need to do is you got to continuously monitor everything. If something goes wrong, you indicate that so-and-so pack is to be replaced, replace that. And there's a few people who make equipment for doing this sort of thing. And they run it as a continuous business because they do not sell you the entire hardware. They lease it to you under the provision that if anything happens, if the cells go bad, they will replace it. They will monitor it online and replace it as in when it's required.

Eric 4Z1UG:

Wow. So UPS as a service?

Arun W8ARU:

Yes, yes.

Eric 4Z1UG:

What a fascinating idea.

Arun W8ARU:

It's slowly picking up. It's not as popular as it should be, but it's going to happen.

Eric 4Z1UG:

We need a few more Texas winters.

Arun W8ARU:

Yes.

Eric 4Z1UG:

Right?

Arun W8ARU:

Yes.

Eric 4Z1UG:

In order to be able to sell the UPS solution as a service. What a fantastic idea. I'm sorry it's not my idea, but it's a fantastic idea nonetheless. What excites you the most about what's happening in amateur radio now?

Arun W8ARU:

Well, the popularity which it's gaining with high school kids. I mean, I would've thought that most high school kids, or high school graduates, or people in high school, or even in grade school, for that matter are more interested in communicating using the internet and using regular social media. But I see that there are more and more kids who are interested in getting into ham radio, and boy, that is something. You need that, at least in the US. You need a lot more technically qualified people. People who would like to work with their hands and ham radio is one of the most, it's about the best way of getting into regular hands-on engineering. I can see that slowly happening, but it's taking longer than it should.

Eric 4Z1UG:

No, but you're the first one in 400 episodes that have said that you think that there's a popularity among high school kids. What could we be doing better to create some kind of, I don't want to say trap for catching high school kids in getting them interested in amateur radio. When we know that they'll obviously only benefit their lives from having done it, what could we do better that we're not doing?

Arun W8ARU:

We have to have... Well, there's a robotics club in just about every school, which is every high school has some sort of robotics club. That way, we should create an amateur radio club in there with some of the local stalwarts. In fact, Dan started something like this a few years back at the Hands On Museum in Ann Arbor. And unfortunately, the Hands On Museum had only kids who were definitely not high school kids. They were kids from grade school or junior high, and they were more interested in all the things which they could touch and feel and what have you, and ham radio took a backstage because of so

much noise these kids were making that the radios wouldn't work well. I mean, you could hardly hear what was on the other side.

Arun W8ARU:

So that was the beginning. But if this is moved over to schools and somehow you have a teacher who has a ham radio license, tries to make it more popular in the school. I think that'll pick up kids like crazy because this is something which you can have kids making antennas, you can have kids making radios, and especially with the QRP stuff, which is available right now, the kits which are available, like the ones which Farhan makes, or for that matter, which hands from QRP labs makes. Yeah, that sort of thing, you have to make it more popular and you just have to push it into schools. I mean, you just have to have a few workshops there with the school authorities and say, okay, this has got to be pushed in. I don't see any other way.

Eric 4Z1UG:

We will return to our guests in just a moment. A new way to show your support of the QSO Today Podcast is to buy me a coffee. I consume gallons of coffee to create this weekly podcast, invite me for coffee by pushing the yellow button, buy me a coffee on the QSO Today show notes page. And now back to our QSO Today, if we have anybody from the ARRL listening to this podcast, what we have to do is we have to increase the size of the Teacher's Institute every summer at the ARRL from about 10 teachers to about a 1,000 teachers in order to be able to drive it. We want to drive it deep into the schools. I mean, how many school kids are there in America? 150 million.

Arun W8ARU:

Absolutely.

Eric 4Z1UG:

Yeah.

Arun W8ARU:

Yeah.

Eric 4Z1UG:

We need to go deeper. Well, I think that's a great idea. One of the things I noticed, for the first times I saw Nuts and Volts Magazine, and it reminded me of the popular electronics of the 60s and 70s.

Arun W8ARU:

Yes.

Eric 4Z1UG:

This seems to me that there's more we can do there. We're talking about recruiting kids into amateur radio, but do you think that's the greatest challenge that we're facing in amateur radio now, or do you think it's something else?

Arun W8ARU:

I think that's what it is because kids have a lot of spare time and they spend it on all kinds of activities, which can be directed to ham radio when it doesn't want to happen. I think that would be a good starter if we have this more and more popular in schools. Well, they've taken the CW portion of it, the most portion of the test, right out of the exam. So that makes it a little more popular. But for fellows like me, who insist on using only CW, that doesn't make sense. But what I'm trying to get across is you just have to get this into schools. And maybe another way of doing it is to have these contacts on ARISS, the ISS from these schools.

Arun W8ARU:

And that seems to be very few and far between. In fact, there was one in Detroit, about six years back. And after that, in this general region, I haven't seen a single one. So that has to be popularized by some of the local clubs. And once kids get to see that they can actually talk to an astronaut who is flying at 19,000 miles an hour above their heads, or 200 miles above their head, that'll change their minds a bit to what is actually out there and what they can do.

Eric 4Z1UG:

I think just about every astronaut in the space station is a ham now, right?

Arun W8ARU:

Yes, yes, yes.

Eric 4Z1UG:

So what an opportunity that, again, I think it's just the availability of ham radio bodies to be able to implement.

Arun W8ARU:

That's true, but there are so many ham, in Ann Arbor itself, there are 130 ham radio operators. Now, you get on the radio, you hear maybe one or two of them every evening, that's about it. And every Monday they have their nets, and they chew about the rag, chew about all kinds of stuff. But once they get focused something like, okay, let's go to so-and-so school, and then just convince them that they should have a program which will allow them to communicate to the satellites, to at least the ISS and set up something with the

ISS administration, which allows them to get a spot. I think that would go a long way and that should be more regular. Right now, it's very, very sporty.

Eric 4Z1UG:

Do you get a chance to go back to India and see what's happening in amateur radio there?

Arun W8ARU:

I haven't gone in the last three years, but I will be going this year and I'll spend a lot of time in Farhan's paradise and see what he's up to there. Yes, that should be fun.

Eric 4Z1UG:

No, I think that would be great. One of the benefits that we all got being together at FDIM and Hamvention is we all came home with COVID.

Arun W8ARU:

Yes, yes. That's very unfortunate, yes. In fact, I'm seriously thinking of avoiding the field day because I am scared. I don't want to go through another two weeks of this mess.

Eric 4Z1UG:

I'm still feeling the effects of it.

Arun W8ARU:

Yes.

Eric 4Z1UG:

But I'm glad that I didn't go to my father after the convention, my 92-year-old father. I actually went and visited before because I knew that if I was going to get something, I was going to get it there.

Arun W8ARU:

Well, I didn't have much of an option. I came back home. Then I had one 89-year-old aunt who was visiting me along with her kid, her son-in-law and their kid, my wife and my son, all in the same house, everybody got COVID. So I'm a pretty good spreader.

Eric 4Z1UG:

It sounds to me like you are. So Arun, do you have advice that you'd give to new or returning hams to amateur radio?

Arun W8ARU:

Well, get on the air is the very first thing, just get on the air. And we have a station doing that. It's called the GOTA, G-O-T-A, which is Get On The Air station, which will be on, on field today. But I think we got to make it more popular. And then anybody who has not done ham radio in years, the first thing would be, there's so much equipment available everywhere. You can go to eBay and buy it if you want, if you don't want to spend the money. Just connect and then talk.

Eric 4Z1UG:

As I say in every episode, all of us who've been in ham radio for a while, have radios everywhere ourselves; under our desks, in our attics, right? All people have to do really is ask us. But what do you think about this? It's better to ask the ham radio operator on your block, in your neighborhood, in your town, for what's under his desk so that he'll come and actually help you get it on the air.

Arun W8ARU:

Exactly.

Eric 4Z1UG:

Right. So don't send me messages unless you're in Jerusalem for my gear, I'm happy to supply, but it seems to me that the best part about this kind of an ask is to ask the local guy to be your Elmer, to be your mentor.

Arun W8ARU:

Right. I have started four or five fellows. I've got licenses for four or five guys who used to work with me. So I think my quota is not complete. I need more fellows. In my present work, we have about 130 guys working with us. And I think three people are already in the line to get licenses. So I'm trying to make it as popular as possible, but it's a bit rough. I mean, we have a full schedule from eight o'clock in the morning till five in the evening, so.

Eric 4Z1UG:

Anyone that reads your Linked-In page and reads the recommendations about you on the Linked-In page knows that you're a fine manager and employer and entrepreneur. So I have one last question. When you are looking to hire someone in your company, in your project, or whatever, does having an amateur radio license, does that help at all, from your standpoint?

Arun W8ARU:

If the resume comes in and it says, amateur radio license, call sign so-and-so I don't even interview the guy. I hire him straight away. I know the guy can work.

Eric 4Z1UG:

Isn't that amazing?

Arun W8ARU:

That's the way it is with me.

Eric 4Z1UG:

It's such a pleasure to see you on Skype again. And you were a fine driver for me at Hamvention. And I had such a great time spending time with you and Asherr Farhan.

Arun W8ARU:

Same here. Oh, by the way, his radio is with me. And I have got it working on FT-8. It is a gem. Did you get a chance to see his new SBITX?

Eric 4Z1UG:

I got a chance, but I'm anxious to see it go into production.

Arun W8ARU:

Right. He said it would be running by the end of this month, but there are still some bugs. If you touch any key, it'll automatically start transmitting. So there are a few things that he needs to work out. But as far as FT8 is concerned, it works like a charm. I mean, I had it connected to a piece of wire outside my window because I just wanted to listen to what FT8 or what the signals can come out of FT8. And then I just typed in my call sign with the other guy's call sign and with the report. And I just waited till the black period show up and I hit enter. Boy, he called me back. I mean, I had how many? Maybe a watt or three watts coming out of it, totally on tune antenna, 14077, if I'm not mistaken. And it worked. And I told him that, look, I got four contacts this way. He said, "Are you crazy? You sure you're not lying to me?" I said, no, the darn works. And now he's putting more bells and whistles into it.

Eric 4Z1UG:

And that's not surprising. And if you're a new ham, that's an amazing way. The whole BITX line, all of his projects, they're an amazing way to get on the air and to gain some expertise at the same time. So if you're a new ham, we'll put a link to that in the show notes page as well.

Arun W8ARU:

Yeah. Even the QRP labs thinks it's phenomenal. I mean, they just get one of their kits, put them together and that can be a club activity, like what we have in the local Arrow thing.

Eric 4Z1UG:

Exactly. Right, right. I think the club activity could be winding the toroids.

Arun W8ARU:

Right, it is true. That's true.

Eric 4Z1UG:

That takes a little bit of-

Arun W8ARU:

It takes a little bit of effort and I don't know whether that'll be very popular.

Eric 4Z1UG:

If you do it and you do it right so that it measures the right inductance. Then you have this feeling of accomplishment.

Arun W8ARU:

That is true. That is true, yes.

Eric 4Z1UG:

Then you have a new skill that you can put on your resume.

Arun W8ARU:

Yes.

Eric 4Z1UG:

Arun, thank you so much. I so appreciate your agreeing to be a guest on the QSO Today Podcast. With that, I want to wish you thank you and 73.

Arun W8ARU:

Thank you, 73.

Eric 4Z1UG:

That concludes this episode of QSO Today. I hope that you enjoyed this QSO with Arun. Please be sure to check out the show notes that include links and information about the topics that we discussed. Go to www.qsotoday.com and put in W8ARU in the search box at the top of the page. My thanks to Icom America for its support of the QSO Today Podcast, please show your support of Icom America by clicking on their banner in the show notes pages. You may notice that some of the episodes are transcribed into written text. If you'd like to sponsor this or any other episode into written text, please contact me. Support the QSO Today Podcast by first joining the QSO Today email list by pressing the subscribe buttons on the show notes pages. I will not spam you or share your email address with

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Eric 4Z1UG:

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