QSO Today, Episode 374, Courtney Duncan N5BF

Commissioned by The Duncan Family

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Courtney Duncan, N5BF, has a humble amateur radio beginning in Texas, where he earned a degree in musical piano performance. Destiny intervened, allowing Courtney to get a degree as an electronic engineer and a career at JPL, the Jet Propulsion Laboratory associated with NASA and Caltech in Pasadena, working on flight radio systems for spacecraft that go to Mars and beyond. Now retired after 30 years, N5BF is as active as ever as the President of the San Bernardino Microwave Society, amateur microwave operation and contesting and moon bounce. N5BF is my QSO today. N5BF, this is Eric, 4Z1UG, are you there Courtney?

Courtney, N5BF:

Yeah, good morning 4Z1UG from N5BF, copy.

Eric, 4Z1UG:

You're loud and clear on Zoom, Courtney. Thanks so much for joining me on the QSO Today podcast. Now, I'm in Israel and you're in Southern California, so we're 10 hours different, but you have an N5 call, why is that?

Courtney, N5BF:

Well, I spent half my life, I grew up in Texas, so I've gotten all my call signs there and just never changed them. I can give you the story from the beginning.

Eric, 4Z1UG:

Let's do that, let's start at the beginning of your ham radio story and see where that goes?

Courtney, N5BF:

Well, I was first licensed at age 16, but I think really credit goes to a couple of things that happened when I was seven or eight years old that kind of indicated that this was an area of interest for me, and of which I'm kind of in awe actually, of how this has worked out in my life. When I was seven or eight years old, I lived in a small town, it's Henrietta, Texas, it's the next flag stop down from Wichita Falls in Texas on the Burlington railroad line.

Courtney, N5BF:

And I was allowed as a kid to ride my bike down to the train depot after school every day and visit with the operator there. This was back when trains still had depots in all the little towns and there was someone there who would sell you tickets and he would operate the telegraph and he would interact with the trains coming and going. And I would go down and watch this and I became fascinated with all sorts of things like how do the trains move? There's these lights that turn green, yellow, and red that indicate how the traffic is going, how do those

lights work and what do they indicate about what the trains are doing? And I eventually figured these things out later on in life, but it was all a mystery, a fascinating mystery to me at the time.

Courtney, N5BF:

And an interesting thing, this was Mr. Montgomery. I think he has a first name, but I don't know that I ever knew it. And Mr. Montgomery was the station master and an amazing thing that he could do, he sat in his office there in the depot with a telegraph key. This is landline Morse with clackers, and he had four different loops that came in there and each one came to a different clacker that ran at a different audio frequency. And he could listen to these things clacking and tell what was going on up and down the line. As the railroads were put in, all the wires were put in, this was all wired communication that dated back to the 19th century.

Courtney, N5BF:

And he had a bug and he could run about 40 or 50 words a minute and it was just all cacophony of noise to me. But at one point, I had been coming around for a long time and he sensed some interest and he got out the straight key with the little practice clacker and he actually taught me American Morse. I wouldn't say that I could do it today, but I would say that this was my first exposure to this magic of using on off keying to communicate with others. And so, that kind of indicated that I was interested in systems, I was interested in how things worked electrically and I was interested in this idea of communication.

Courtney, N5BF:

Now, another thing happened right about the same time. We would watch TV and this, again, is back in the early sixties when all TV was over the air. And we're out far away from the big city, where we only had three stations that we could even get over the air. But one day, we were about 100 miles or 150 miles from the Dallas Fort Worth metroplex, and one day we started getting Channel 8 early in the morning. And I knew that this wasn't supposed to happen. Channel 8 wasn't line of sight from here, and so we weren't supposed to be seeing that. And so I asked dad, I said, "What's going on here?" And he says, "Well..." He knew it had something to do with the atmosphere and sometimes this happens in the morning and then the thing faded out to snow and then it was all gone. But I thought, "Well, that's interesting that the atmosphere does things to TV signals that aren't expected, that aren't standard," so I was kind of curious about that.

Courtney, N5BF:

So then, fast forward a few years ahead. So, I was clearly a candidate for amateur radio and as an introvert, I kind of had one friend in each of the places where we live. We lived several different places, dad was a preacher, and we moved every two or three or four years while I was growing up. And so, we left Henrietta and we were a couple other places and when I started high school in a town down near Austin, Taylor, Texas, had a good friend there. My friend there was Rob Anstoos, and he and I did many technical things together and we were kind of proto scientists and we rode our bikes around and did various things. And when I moved away from there, he and I both had the idea at the same time without communicating

with each other, that we should get into ham radio so that we could stay in touch with each other and save postage. Now, that's a joke, because if you can consider the number of stamps you could buy with the amount of time and money I've put into amateur radio since then, it's pretty hilarious.

Eric, 4Z1UG:

We are talking like a four or five cent stamp in those days, right?

Courtney, N5BF:

Yes, yes, it was five cent to postcards and, I think, letters, we were sending two, three page letters, it was 10 or 12 or something like that. Right, so several years of that would add up to an accessory. But yes, so we had this idea and we wrote to each other, we actually crossed in the mail with this idea that we should get on ham radio. And basically, I had the idea, because there was a ham there in Hubbard. I was now living in Hubbard, Texas, which is close to Waco, it's about 100 miles south of Dallas area. There was a well known regionally renowned ham who was part of the church there and he'd approached me after church one night and said, "If you're ever interested in learning more about ham radio or getting involved, just let me know."

Courtney, N5BF:

And this kind of cooked in my head and Robbie had a similar thing happen on his side. He had a mentor or an Elmer who basically approached him similarly and he had had an older brother that had done this. And so, we had this idea anyway, and it was kind of fascinating that it just happened at the same time and we crossed in the mail without any idea of what was going on. And so, then we started down this road of trying to get on the air. And this is back in the seventies, when you would get a novice license and you'd put together some kind of surplus or home brewed station. And he got licensed. His call was WN5FID and I got licensed about six months later. My call was WN5GRZ and it's just the process that it took.

Courtney, N5BF:

And then he got on the air, but he was only on 15 meters, only on the 15 meter novice band and we were about 100 miles apart, so we came up with all these elaborate plans of how we were going to make a 15 meter contact from kind of minimal stations, because that's all we had and somebody was going to get on and ask for a relay and whatever. None of this ever actually happened, but that was kind of the planning process. And in this whole process, it took about a year and a half, about 500 days from the time when we crossed in the mail till we were both up on the air.

Courtney, N5BF:

And the rig for this novice experience was a crystal-controlled homebrew single tube, 6DQ6 transmitter that had been probably in QST in the fifties or something. And for the receiver in old national, I couldn't find online exactly what it was like, but it was kind of like the HRO-50, except it didn't have the band coils on the bottom. It had a big knob where this box... You changed bands by moving this box back and forth in the bottom of the 50 pound radio unit. And the lowest band was 200 to 400 kilohertz and you could listen to, I don't know, whatever

was down there. There was carriers and things. And the upper one was kind of five to 30, and of course that's where all the short wave was.

Courtney, N5BF:

And so, the thing I'll say about this though, was that radio had no... It had a BFO, kind of as an afterthought and it did not have anything else. There was no AGC, there was no selectivity of any kind. I would get on and based on what was going on in the air, I would adjust the RF gain to make it linear and then I could hear everything 20 kilohertz plus and minus from where I was. And I kind of learned on CW to discriminate just by ear. I learned how to tune and how to listen to all this cacophony and to pick out the signal I was interested in, much to the consternation of all my friends, I thought this was actually kind of fun to be able to do that.

Courtney, N5BF:

And the other feature of this first transmitter is that it's crystal-controlled, but it had a chirp of about 500 Hertz when you'd key down and go "pew, pew, pew". And so, people knew who I was, but when I came on the air, they knew it was me because there was this chirp, and that was particularly bad when we tripled onto 15 meters, right? So, people complained that it went out of their audio pass band and I would say, "What's an audio pass band, why can't you just hear everything?"

Eric, 4Z1UG:

Did you have a mentor there? You mentioned this guy that you met at church, did he end up being your mentor?

Courtney, N5BF:

Yeah, so he was my Elmer. This was Phil Woodard, W5KRZ. And his story was that he'd been a lineman for the power company for many years, climbing poles and putting in transformers and different things. He'd gotten into ham radio right before World War II started and he was ready to go on 160 meters, right when the war broke out and he never did. But after the war, he had come back on and he'd basically gotten on 5-Band HF, which is what it was then and he'd done DXing and he'd done all the things that people do. But by the time I knew him, he was 75 meters only. He was still equipped for everything else, but the place he hung out was on 75 meters, which was kind of a regional band where all the guys got together early in the morning to talk to each other.

Courtney, N5BF:

And so, this is what I was mentored into. I started out on 75 and 40 meters and what we now call near vertical incidence skywave, NVIS. Well, that just all seemed obvious to me. That's what you did, you put up a low antenna and you burn clouds, and you talk to people from local all the way up to two or 300 miles away in meters. And so, that's how it all started. He was not a CW guy, but I turned out to be one and from there I launched off into being part of the National Traffic System. I was a liaison between CW and phone nets for a while, while I was in my later high school years there.

Courtney, N5BF:

And so, the rest of the story about my Elmer, W5KRZ, I went over to his house several times a week for probably months. I don't remember in detail anymore, but I learned all about his shack, all about his operation, all about electronics. He and I would just chat about stuff, we'd look at diagrams, we'd figure out things. He gave me the novice test and I didn't think I could do it without a typewriter, so I brought a typewriter over to his house so I could copy the five words a minute and he just tuned in something on the air and I just copied it for a while. And he said, "Yeah, yeah, that's good enough." And so, I was on the air, but within... Let's see, I want to say... So, I was first licensed at the end of March in 1972. In March 1973, a tornado came through Hubbard and Phil was the emergency communication out of town in the aftermath of that event.

Courtney, N5BF:

It was a tornado that you'd call... It's been classified in retrospect as an F4, so that's a pretty big one. And it went across several dozen miles, but it ended up going through Hubbard. It missed the house that I was in, and this was early on a Saturday morning, it missed the house I was in by 10 or 15 yards. It missed the storm shelter that Phil was in by three or four blocks. And he always said he was the emergency preparedness guy in town, he was the one who had gasoline in the hospital generators, so everybody knew him, everybody knew what he was going to do. And he said, "If there's a tornado warning, I'm going to the underground shelter and only when it's all over, am I going to come up and turn on any radios."

Courtney, N5BF:

And so, he had actually done that that day. And he came out and there was moderate devastation in many places and severe in some places. And he went right on the air and got on 75 meters and a local net kind of formed itself from the North Texas emergency net infrastructure. And being close, my house being close to the tornado, all my antennas, everything that I had, had blown down. The house itself was only very minimally damaged, but I was off the air. But I walked over to his house during the event and I was a shift operator for some of that.

Courtney, N5BF:

And after that event was over, it took all weekend to even just get the power back on. And he had been feeling sick and he checked himself into the hospital and he had a serious condition and only lived another month or so. And so, that was kind of the end of my Elmer experience, but I'd say it was an excellent one. He was a guy who just knew everything at the time and was willing and actually eager to talk to me about stuff and just to bring me along. And, of course, I moved way beyond 75 meters as we will discuss later on, but...

Eric, 4Z1UG:

Courtney, were you the only high school ham in Hubbard in those days or was there a radio club at your high school?

Courtney, N5BF:

So, there was not, Hubbard is a town of two or 3000 people. The high school class I was in was 36 and...

Eric, 4Z1UG:

Small town, right?

Courtney, N5BF:

It's a small town. And there was another person or two who had a little bit of technical interest. And I'd kind of get acquainted with them and do things, but no one ever... And Phil himself said this, he said, "No one's ever come through town that was as interested in this stuff as you are." So, he was happy to made that connection.

Eric, 4Z1UG:

Well, anybody that knows you, will know that the next question is probably not necessary, but we're telling ham radio stories here. Did ham radio play a part in the choices that you made for your education and career?

Courtney, N5BF:

Well, it didn't at first. And the reason I say that was because... So, we all went off to college and of course I took some radios with me. A funny thing, I got involved with a repeater group in nearby Hillsborough and they had bought some surplus taxi cab radios, some GE prog lines from a nearby town and re-tuned them and repurposed them and re-crystaled them to a local repeater that we were putting up. And so, for some reason, every radio I had at the beginning was 50 pounds. And this was one of those things where the radio went in the trunk and then you had this 15 foot cable with 50 wires in it that came up to a control head.

Courtney, N5BF:

And so, I had all this set up. And I went off to nearby Baylor University in Waco, and I lived in a dormitory with a... I was in the cheap rooms, the fifth floor attic, and there was no elevators in the building, so I'm lugging this 50 pound radio plus a car battery that was needed to power the darn thing, up these five flights of stairs to get into my room. And then of course, because I was in there with a bunch of other people, I had to leave the thing off most of the time, because they didn't want to hear all that, so that's kind of entertaining, but that's kind of what happened.

Courtney, N5BF:

But I went off to Baylor and I was actually a music major, a piano performance major and I did some ham radio stuff at Baylor, but at the time, there was no radio club there either. There was a few hams around, but then you'd eventually find them. There was a Heart of Texas Amateur Radio Club that had a few students in it. But as a ham, I mean, this is the great thing about ham radio at the time and maybe it's still true is that you show up in town, you show up on frequency and all of a sudden you have a bunch of automatic friends who know each other and they know where to go eat and they know the traffic problems in town, the places to avoid right now and so forth. I mean, you just get on the air and you just be part of this local community, even if you'd never met the people before.

Courtney, N5BF:

And so, that's kind of what happened. So, the big thing I did while I was a piano performance major was that's when the Heathkit 2036 came out and one weekend I built up one of those. That was a synthesized two meter rig, it probably only weighed about five pounds. It was a huge improvement over the prog line that took a half an hour to move from the room to the car, to the room. It wasn't portable, but I acted like it was.

Eric, 4Z1UG:

The Heathkit had the rotary switches for setting the frequency?

Courtney, N5BF:

Yes, but the offset was done by an internal crystal that you had to net in. So yeah, but the main received frequency was set by, I think, three switches, yeah.

Eric, 4Z1UG:

I think I remember that rig. What's interesting to me is that if you were a piano performance major, you must have been pretty good?

Courtney, N5BF:

Well, it depends. When you talk about music schools they say, "Well, we don't care where you went to school, we care how well you play." So again, the music department at Baylor, I wouldn't call it huge. There was probably a dozen other piano performance or versions of that when I was there and you had to be pretty good just to graduate. I mean, I'm not going to say, because I don't really know where I would rank among all the people I went to school with, just to get into and out of music school.

Eric, 4Z1UG:

But did you graduate with that degree?

Courtney, N5BF:

Yeah. Yeah, I graduated with that degree.

Eric, 4Z1UG:

What was your plan? I mean, my twin brother's a music major, his plan was to be a music teacher, what was your plan?

Courtney, N5BF:

Well, they do have courses in how to be a music teacher because they know that pragmatically that is likely to happen.

Eric, 4Z1UG:

You have to eat.

Courtney, N5BF:

Right, but there was a sense in which this was all kind of altruistic. This is all about art history and the greater good. And job training, well, that's not exactly what college is about. I guess it kind of is, but that was not the attitude there.

Eric, 4Z1UG:

Van Cliburn also came from Texas.

Courtney, N5BF:

Yes. Yes, that's right. And this was kind of in line with that, right? I mean, he had been a great hero of the Cold War and people looked at me, I was pretty good at piano, and they said, "Wow, we could have another Van Cliburn here." Of course, if you look at it geopolitically, that kind of situation is not repeatable, but that didn't mean that it wasn't popular, that he didn't create a lot of buzz.

Eric, 4Z1UG:

And he could play a little bit as well, with all of that, he was actually a pretty good player.

Courtney, N5BF:

Oh, yes, yes.

Eric, 4Z1UG:

That's amazing. So, what happened after that?

Courtney, N5BF:

Yeah, so what did happen? Well, so I'll first say that as far as what was my plan, well, I just retired from JPL last July and looking back on my entire career back to that moment, I don't think I really ever had a plan. I kind of said, "Well, I know some stuff about music, I know some stuff about electronics." I basically went to work in broadcasting. I found my way into TV and radio and I worked at radio and TV stations for a little while and that worked out, I kind of had the basics for that. But what happened was, if you don't have a plan, life has a way of saying to you, "Well, you need to make one."

Courtney, N5BF:

And one way in which this happened to me was that I would go places and kind of ask people, "Well, how do you get a job here?" For instance, Robbie and I, we were both first novices, which is just a test given by typically an Elmer, but when you go to get your real license, you have to go to the FCC office.

PART 1 OF 4 ENDS [00:27:04]

Courtney, N5BF:

You go to get your real license, you have to go to the FCC office. And the FCC office that was nearest to us was in Dallas. And so he would come up for a weekend visit and they only gave amateur tests on Tuesday morning at eight o'clock. And so we'd get up at five o'clock and dad

would drive us up to the FFC office in Dallas and we would go stand in line at the post office downstairs and get our nine dollar money orders because you had to pay with a money order. And then we would go up and we would be given code tests and the multiple choice tests that you were given.

Courtney, N5BF:

And he and I both upgraded through the system while we were doing this and I would always take the next test and fail it, because I hadn't studied for it. But I said, "Well, I paid my nine dollars, I might as well take a shot at it." So, eventually, several trips to this I did what a lot of hams did. I got all the way to extra this way and I took some of the commercial radio telephone tests that enabled... That was required to work in broadcasting at the time. And I had some of those too and let me see, this train of thought was leading someplace.

Eric, 4Z1UG:

And now this message from ICOM America. Spice up your ham shack with ICOM's IC-705. This portable radio is perfect for staying in and venturing out and working your favorite bands this winter season. Happy holidays from ICOM. The ICOM IC-705 is the perfect sidekick and QRP companion. Base station features and functionality at the tip of your fingertips in a portable package covering HF six meters, two meters and 70 centimeters. This compact rig weighs in at just over two pounds with RF direct sampling for most of the HF band and IF sampling for frequencies of above 25 megahertz.

Eric, 4Z1UG:

It has a 4.3 inch touch screen with live band scope and waterfall display. Five Watts with a BP-272, 10 Watts with the 13.8 volts DC power supply. Single side band, CWAMFM as well as full D star functionality. A touch screen display, micro USB connector, Bluetooth and wireless land. Integrated GPS with antenna and GPS logger, micro SD card slot, speaker microphone using the HM-243 and it comes standard.

Eric, 4Z1UG:

So it supports QRP and QRPP operations. The perfect accessory for the IC-705 is the optional LC-192 backpack with its special compartment for your IC-705 and room for accessories for soda activations or a day out in the wild. Our family of favorite icon amateur radios are also available this holiday season, the IC-9700, the IC-9300, the IC-7610 base stations, the ID-52A handheld coming soon. And the ID-5100A mobile are the perfect gifts. And it's the most wonderful time of the year to have a gift of icon. For more information, click on the icon banner in this week's show notes page. And when you purchase your new icon rig, please tell your dealer that you heard about it here on QSO Today. And now back to our QSO. You were saying that life has a way of pushing you down a track.

Courtney, N5BF:

Yeah. Yeah. So I would I'd be at the FCC office and I'd be standing there with the engineer handing in my paper and I'd say, "Well, it looks like you have an interesting job here working for the FCC. What's involved in getting such a job?" And they'd look at me and they would think, "Oh, you must be a double E." He would just assume that. And he'd say, "Oh it's

nothing come in as a GS9 and it's just a civil service thing and you just apply." And I had this happen several times. So I was involved in amateur radio satellites. I had this receiver that would receive 10 meters and I first heard Oscar 6 from my home in Hubbard, Texas.

Courtney, N5BF:

And later on when phase 3A was lost in a launch accident, I applied to go work at the AMSAT lab in Washington, where I first met Jan King, W3GEY. The same thing happened there. I went up there and he assumed I was a double E or a math major or physics or something like that. And I said, "Yeah, I'm a piano performance major, but here I know all this stuff about ham radio." And so I didn't end up getting the job, but I did... After this it happened in several different times and several different venues. I thought, "Everybody thinks I'm a double E I need to go fix that." And so along about, when was it? About 1980, I went back to college at University of Houston and got a double E degree.

Courtney, N5BF:

And by now I was older. I knew how to go to college. I did really well. I had a high GPA. I even went through the honors program. I mean, I basically did the whole thing again. And when I got out of that, I was basically qualified on paper to go get those jobs that I had been asking everybody about for all these several years. So yes, amateur radio had a significant input into my eventual career, but there was never really a very cogent plan.

Eric, 4Z1UG:

I would say that I get that absolutely, almost 130%. So let me ask you, so what happened after that? Because I've got a whole list of stuff here that's kind of related to what happened after that. It'd be interesting to hear what was that first job out of the University of Houston?

Courtney, N5BF:

Well, so while I was at University of Houston, I co-oped at Johnson Space Center and which is just nearby. And I was there for a couple of semesters in alternation with schoolwork. And I was there during the STS-6 and 9 flights. And I think it was STS-9 that Owen Garriott was on the first time that we'd had amateur radio on the space shuttle. So I was there for that. And I would actually go to Johnson Space Center, amateur radio club meetings and Owen Garriott and other people like that would be there. That was kind of impressive.

Courtney, N5BF:

But here is the story about how I ended up at JPL. I got close to the end of my double E degree at University of Houston. And unlike myself, I was actually thinking, "Well, maybe I should have some kind of plan here." And so my approach to that, I went down to the library one day and I started just looking through stuff in the technical section. And the whole idea was just to look at things and see what I found exciting or interesting. And so as I was going through magazines, books, periodicals, technical journals, I started to notice that about half of the material there that I found interesting or fascinating had bylines from JPL and the other half was spread out all over the place. Different NASA centers, different companies, aerospace and various other things.

Courtney, N5BF:

But half of them were from JPL and you mentioned the Deep Space Network. There's a lot of talk about what was then for now the 70 meter dishes out there and possible noise figure receiving systems and very high power transmitting systems. But there was also a lot of pieces about what we would call state of the aircraft that leave the earth and go off to different planets and other... We think of satellite communication as kind of utilities now, it's just kind of normal. But the spacecraft they're going off to look at other planets for the first time or to look at Neptune or Mars or whatever, that seemed very interesting.

Courtney, N5BF:

And so, as a result of this, I basically made a cold application to JPL and went and got a different job for a while. And it took about a year for the whole thing to go through the system. But I ended up someone picked this up basically based on my... Well, let me see, let me back up a little bit. One thing we missed in this University of Houston college experience was that back while I was doing that, back while I was doing the coursework, I also became very involved with AMSAT, what is now AMSAT North America.

Courtney, N5BF:

Under the mentorship of Ralph Wallio, W0RPK, who was then vice president of operations. And what they needed that I could do was a satellite tracking program on a cheap computer which in 1983, was to find as the Timex Sinclair ZX81 computer. I don't know if you remember those things, but it's a little, Z80-based thing, right? And the Z80 spent most of its time painting the TV screen for the TV that you provided as the monitor and during the vertical sync interval, it would do other calculations that you had programmed in BASIC.

Courtney, N5BF:

And I wrote this program that would... And you had to load it off of a cassette tape at 110 broad. This was a huge pain by the today standards. It literally took, what? 10 minutes to either save or load that program. But I wrote this program that you would type in the Keplerian elements for the satellites and it would provide past predictions and real time tracking information that you would use manually. Right?

Courtney, N5BF:

You'd look at the screen, you'd see the S making elevation numbers. You'd dial those into your rotors manually. This is long before and that computer wouldn't have had anything like the capacity to do automatic control. But I wrote this program and we iterated several times and made it into a releasable product and that became something that went on my resume. And the guy at JPL, Larry Young, who was going to be the hiring manager. He saw this on my resume and they actually needed something like that for a scientific grade GPS receiver they were developing.

Courtney, N5BF:

This was basically... I mean, I had written this in basic, so it's not exactly embedded soft, but I had done some embedded work professionally and he knew that's what they needed. They needed this GPS receiver to have embedded code that would do satellite tracking and other

computations like that. And so he picked that up on my cold resume and after nine or 10 months, we finally made a deal and I moved out here and to California and have been here ever since. I had a 34 year career at JPL, the first dozen of which we were working in GPS receiver technology based on that background.

Eric, 4Z1UG:

Using the Z80, perhaps.

Courtney, N5BF:

Well, so it wasn't the Z80, oh, gosh, it was a 68,000, I think, in the GPS receiver here. But yeah, I mean, this was the '80s, right? So.

Eric, 4Z1UG:

Right. But I remember that Motorola had a whole line of microprocessors, 8-bit microprocessors after that. Let me ask a question about JPL for those of us that really don't know the history of JPL. JPL is owned by, you said its own corporation? Is it a nonprofit? What is JPL?

Courtney, N5BF:

Yeah. So this is complicated. It is a NASA center, but unlike the nine other NASA centers it is not a civil service, government employee NASA center. It is a FFRDC, a Federally Funded Research and Development Corporation and under the auspices of Caltech. So people that work at JPL are Caltech employees and they work on US government property at a NASA center. And that is the simple description of an extremely complicated relationship.

Eric, 4Z1UG:

Would that be the same kind of relationship that maybe the Lawrence Livermore Lab has with the University of California? I mean, is Lawrence Livermore, for example, owned by the University of California or is it also a federally?

Courtney, N5BF:

That is another example of an FFRDC. So that's what it is. And FFRDCs have their own rules about everything, about taxes and audits and intellectual property ownership and all that sort of thing. But basically as a JPL employee everything I do is owned by Caltech and it basically goes from there, so.

Eric, 4Z1UG:

And because it's called the Jet Propulsion Laboratory, it probably had early roots in propulsion systems for aircraft or rockets or things like that, right?

Courtney, N5BF:

It did, right. So the joke we like to tell at JPL is that we never worked on jets at JPL and we never will but what it was JPL was basically a Caltech graduate project in the 1930s that got out of hand. And what they were doing, they were trying to build rockets and they'd go out in the Arroyo of North West of Pasadena, where the JPL campus is now, but there was nothing

out there at the time. So if they blew stuff up, it wouldn't hurt too many people. They went out in the Arroyo and they did these rocket tests.

Courtney, N5BF:

And so it started out being a Caltech to, like I said, a graduate student project that got out of hand, but then the late '30s going into the '40s, this became a very interesting thing for military uses. And so JPL for a couple of decades was basically a classified installation with contracts, with the US army to build rockets to do various things. Jet assisted takeoff rockets was one of them. You'd mount these rockets on the back of any airplane and you'd get extra thrust during 30 second takeoff role to try to get you off the ground as quickly as possible.

Courtney, N5BF:

They also built rockets to carry warheads in regional conflicts and that didn't end, but in 1958 with the formation of NASA, JPL was made into a NASA center. And the major emphasis of what we've done since then has changed to peaceful civilian exploration of the planets. The story goes that Bill Pickering, who was the director when this happened they were going to divide NASA up into a manned program, an earth program and a solar system program. And he went in a smoke filled room with some other people and JPL came out with the solar system exploration part. And Godard in Maryland, came out with the earth part and Johnson Space Center in Houston, came out with the manned part. And that's the way it's been ever since.

Eric, 4Z1UG:

Just as a little bit of background before we deeper dive, what are some of the most notable JPL successes?

Courtney, N5BF:

It's funny to ask it that way. The JPL, I think it was first really publicly known for the ranger missions. These were the ones in the mid '60s that went to the moon and did not try to soft land, but they just impacted the moon with the television camera running. So you could see the moon getting closer and closer, but the reason I say it's kind of funny, you ask it that way is because the first six rangers failed for various reasons.

Courtney, N5BF:

One, was a launch failure. One, it worked perfectly, but it didn't end up at the moon. One of them turned on too early and the battery ran down and everything else was fine. I mean, just this large litany of things that go wrong. We basically learned all the hard lessons of the space business trying to do that. And finally, Ranger 7 did what it was supposed to. It went to the moon, it transmitted live pictures as it was crashing into the moon. And the last couple of frames, you can actually see some pretty high resolution detail of that little piece of the moon where it was going to crash.

Courtney, N5BF:

So that is one thing. And then the Mariners... No, wait, the surveyors there was several surveyor missions that went and did soft land on the moon. One of these Apollo 12 landed

close to and the astronauts went down and got some parts off of the old surveyor that had been there for, I think, 18 months at the time and brought them back to earth. And so we have the scoop and the TV camera and stuff that has been to the moon and came back with the Apollo 12 astronauts.

Courtney, N5BF:

And then I think the one big mission that JPL is known for most widely is probably Voyager. A grand tour of the planets was... The alignment of the planets enabled a visit to all the outer planets for only one time, every 176 years or something like that and this occurred in the '70s and '80s, and there's a long story of all the politics and various versions that this went through. But in the end, JPL ended up sending Voyager 1 and Voyager 2 off to visit Jupiter and Saturn by gravity assist from Jupiter. Then by gravity assist from Saturn Voyager 2 went on to Uranus and by gravity assist there went on to Neptune. And these two were launched in the summer of 1977 and Voyager two flew by Neptune.

Courtney, N5BF:

That's basically the end of its sensible mission in 1989, right after I had started working here. And I think they're both still in contact today. Voyager 1, I believe this is correct. It is the furthest object that we still talk to all the time. And the light time out to Voyager 1 is like, it's more than a day now. So the way I like to tell the story you get up on Monday morning, you send a command to Voyager 1, you come in on Wednesday and see if it answered. And it's not really doing much anymore it's out looking for the Helio pause, which I think has been found.

Eric, 4Z1UG:

And it's pretty amazing. Maybe we take these things for granted, but I think it's quite amazing that we've actually sent something beyond the solar system and we can still talk to it.

Courtney, N5BF:

Yeah. It's well out of the solar system now over a 100 AU, astronomical units is the distance of the earth to the sun. It's over a 100 times far away, maybe getting close to 200. The solar system kind of defined as the orbit of Neptune, which is 30 AUs real astronomers would debate the details of that. But for planetary purposes that's where the big planets end. So and it mentioned that JPL, it has many big missions that are well known. Of course, the Mars rovers. There's a couple.

Courtney, N5BF:

Well, there's... How many of there been? There's been, I guess, five now total, including one that just landed last February and the Galileo mission to orbit and study Jupiter for a long time. The Casini mission which went and orbited and studied Saturn for several years. Both of these missions were ended by crashing them into the planet and so that we wouldn't have human artifacts interfering with possible life that may be eventually discovered at these places, more likely on the moons than on the planets themselves.

Courtney, N5BF:

But so there's this whole host and big missions and little missions. I mean, at the time of the end of my career we were in the process of launching kind of one a month on average. 10 or 12 missions per year to go do various studies out in the solar system.

Eric, 4Z1UG:

How many employees does JPL have?

Courtney, N5BF:

So the Caltech employees is on the order of 5000 and then there's some contractors that are another 1000 or two.

Eric, 4Z1UG:

It's a pretty big place. How many hams do you think there are at JPL?

Courtney, N5BF:

Well, when I started here, the amateur radio club, I think it had about 200 names in it, but there were several people. Jay Holliday W6EJJ comes to mind in this respect. But there were people who would go around and look for Cal-sign license plates and if they didn't recognize the Cal-sign, they would look them up and say, "Hey, you work at JPL, you should be part of the club." And so I would say several hundred. I think that's probably safe. And as far as club activity goes it's like anything else, some people go to clubs and some people don't, but even now there's an active club with probably 50 or 75 people who are participating.

Eric, 4Z1UG:

Do you think that the hams at JPL had and have an impact on maybe the engineering direction that JPL takes?

Courtney, N5BF:

Well, certainly in communications. The organization I was in at the end was what we call the flight radio section. There's one section that builds the radios that go on the deep space missions. There's another section that deals with the other end of the link, the radios that go into the Deep Space Network and so forth. There's a lot of hams in those organizations.

Courtney, N5BF:

I would say that my career and my connection with those hams has been partly instrumental in moving around inside JPL. It hadn't been the only factor, but it's certainly been one important factor. And yes, in the flight radio section, there's probably maybe 40% of the people in there are licensed radio amateurs. And the interesting thing is people you'd think ought to be, they'll get too busy to take the test, but then they'll come along later and get a license just because they think this is cool and looks like fun.

Courtney, N5BF:

We've actually had some recruiting happen among people who were real radio wizards and by that respect ought to be hams. So yeah. So there's been a lot of direction. We might talk about Mars helicopter a little bit at some point, but I'll tell the story that...

Eric, 4Z1UG:

Well, we can talk about Mars helicopter now. I obviously have questions about the Mars helicopter.

Courtney, N5BF:

Well, so in answering the question if hams had any influence on this, so what happened was that they went to build Mars helicopter and Mars helicopter needs to weigh 1800 grams or less in order to be able to fly on Mars at all because the air is so thin and we're restricted in the size of helicopter blades that we could have. And so mass was the driving factor and we just... Well, the mass was always a driving factor in space missions, but we typically build radios for space missions that are on the order of five kilograms or three kilograms or something like that, that have nice, fully featured digital signal processing and filters and all the important things that go into radios.

Courtney, N5BF:

But on the Mars helicopter they really needed something that was going to be a few grams. And really the only way to do that was to go out and buy something off the shelf that was a radio that was a few grams. And what we ended up choosing was a little Zigbee part that's meant for home automation systems and you can get in bulk for $60 a piece and it weighed five grams when we bought it. And then when we got through with it, modifying it for helicopter use it weighed three grams. And so we had this little off the shelf thing and we had several hams involved in this because in fact, the designer was the late Eric Archer in Six TV. He's the one who actually made that choice, who did the original system engineering studies.

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Courtney, N5BF:

Someone who actually made that choice, who did the original system engineering studies, but there came a time when they needed somebody to lead the project and they called me in and they said, "You're a ham, you know how to make stuff work in ways that wasn't quite intended, cheaply. So here go do this."

Eric, 4Z1UG:

What an interesting reputation.

Courtney, N5BF:

Right. Well, you know what? When I think about what hams do, I mean, repurposing things to not quite what they were intended for when they were made is one of the big ones, right?

Eric, 4Z1UG:

I think that's quite amazing what interests me and hopefully will interest the other people that I'm asking questions for, what do you have to do to a radio like that so that it actually even survives the temperature extremes on Mars? I remember at one time building a project for an electric company where I had to make something work at 30 degrees below zero. I can't imagine that Mars would be 10 times worse.

Courtney, N5BF:

Right. So the going in problem that all of us had who were supplying any electronics to this was that that's about as warm as it ever gets. It gets up, well, sometimes on a really hot day, it'll get up around zero.

Eric, 4Z1UG:

Right.

Courtney, N5BF:

So we all have this problem that we're using earth temperature electronics, and we're going to put it on something that is going to be turned off at night at 120 below centigrade. And during the day when we're getting ready to fly and we're getting ready to turn things off, it might get up around -20. And then when we're flying, we make our own heat while we're actually in operation and turned on. So we get up to zero or +10 or +30 in some cases. But we would be operate in environment where there's not much air and it's -20 at best.

Courtney, N5BF:

And all these commercial parts you buy, they come in a package that says, "This is good for -40 to +85." And they don't say much more than that. Right. So, it wasn't just me, everyone had this problem. So what they did, as mass free as possible, they made a little Mylar box that would trap any heat that we had and all the electronics went into there and they didn't actually guarantee, but they tried to say, "We will keep this above -40 and you're required to survive down below -40. And we'll try to keep this above -40. And that's where you're going to operate, self heating, not withstanding." And we ended up in a situation where the main issue on the helicopter in terms of temperature was that they didn't want the battery to freeze overnight.

Courtney, N5BF:

And so there's a heater that's under FPGA control that kept the battery in the range of -10 or -15. And all the rest of the electronics was close, centimeters away. And so we kind of benefited from that. So we don't have actual measurements for this because we didn't have the mass to send along, thermistors and things to actually measure what happened, but the predict for the radio was that it wouldn't go below -42. At that point, we just crossed our fingers and hope that it'd be okay.

Eric, 4Z1UG:

So let me ask you, Courtney, does JPL have standard communication packages that they put on this stuff? I mean, do you guys now have a warehouse to go in and say, "I'm going to take

receiver or microwave link XX off the shelf." I mean, did you end up creating standard radio packages that went on these missions?

Courtney, N5BF:

So the answer is yes and no. And I'm not sure how much trouble I'll get into by giving my own opinion on this. But the attempt has been made for at least the last 20 years to have a standardized package. For deep space transponders, and these are typically X band, 7.2 GHz up in 8.4 GHz down, that do both navigation and communication using standard deep space protocols. There's been a radio for the last 20 years, the Small Deep Space Transponder, the SDST, that 100 different copies have been made, counting all the spares and things and all the missions that that's supported.

Courtney, N5BF:

More recently in the last 10 years, the organization I was in has a new design called the Universal Space Transponder, which has a lot more reconfigurable digital signal processing unit than the SDST did. The SDST has a CMOs prom that has all of the signal processing and protocol in it. And so that can't be changed in flight, whereas the USTs, the FPGAs, they can be changed in flight. And we also have a CubeSat version of this called the Iris that is basically one FPGA and single channel transponder where everything is under digital configuration and control. And it's about a kilogram and it's about 1U of a CubeSat, which is kind of one, well, actually it's about a half a U of a CubeSat, which is about half of the liter. And it uses a lot of power for CubeSat, 20 or 30 Watts at full trans. But that was kind of the state of the art with the commercial parts we built.

Courtney, N5BF:

So the short answer is we have tried to have a standard approach to all these things, and that is kind of the right thing to do. But every single one of these in turn ends up being a custom build. I said there was a hundred SDSTs out there, but every two or three of those were their own contract and they had their own slight differences in requirements. And so they kind of had to be built up special for whatever the mission particularly wanted.

Courtney, N5BF:

And there's pros and cons to this. So it's not like we have a warehouse with some SDSTs or some USTs where we go get one and just put it on a mission. It's like we say, well, we have this design, we have this architecture and we're going to sell you a copy of that along with an engineer who will really understand your problem and customize it to the extent necessary to your situation.

Courtney, N5BF:

And when you think about it... So I struggled with this issue over my career. When you're building a cell phone, you kind of know what the communication parameters are going to be, what the range needs to be, what the power levels need to be when. When you're building something to go... where one copy might go to Venus and another copy might go to Neptune, you don't really know, right. I mean those are very different communication problems just from the difference in distance alone... Plus the fact that the Venus

environment isn't very friendly to X band, and so you might have to go to a different band. So there's a sense in which these kind of do need to be custom at least per destination, and that's kind of the way it's ended up being done.

Eric, 4Z1UG:

I want to 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 many 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.

Eric, 4Z1UG:

And now back to my QSO, you wrote a paper in 1989 called Microstat: A New, Small Satellite Bus Concept and you wrote that, I think for AMSAT. Did the CubeSat concept come from this paper? Can we call you the father of the CubeSat?

Courtney, N5BF:

No, I am not the father of the CubeSat, but I can tell you my perspective on it. So it's funny, that paper was about a set of four kind of semi standard satellites that AMSAT North America built for four different organizations. One for themselves, one for AMSAT Brazil, one for AMSAT Argentina and one for Weber State University in Utah. And those were Oscars... What were they? 16 through 19 respectively. I'm not remembering this exactly.

Courtney, N5BF:

But anyway, there was this idea of standardizing the satellite, and it was kind of a cube in shape and it was kind of stacked up like a CubeSat ears. In that paper, it talks about the five slices that are stacked up into the satellite and it's a power system, a transmitter, a receiver, a processor board, and TSFR, which meant this space for rent.

Courtney, N5BF:

That's where you, the customer, put your thing, whether it's a camera or a CW transmitter so that you can have built something that went into space or in the case of [Dove 01:04:08], it was a voice synthesizer, so they could send messages a piece around the world. So that was kind of the idea, was to make a standardized form factor. And it was cubicle, it was 10 inches cubed instead of 10 centimeters cubed, like the CubeSat. And so I'll give credit for the CubeSat, where I think it belongs.

Courtney, N5BF:

With Bob Twigs, whose call I have forgotten. He called me up sometime in the early '90s when he was at Stanford. And he said, "We're going to get into this small satellite thing. And do you guys at JPL want to participate or contribute or have some involvement in this?" And

that didn't really work out into something that we could do, but he went off and basically created the CubeSat at that time.

Courtney, N5BF:

And the whole idea was that you take the whole launch manifesting problem away from the University or whoever's building the thing and you standardize that in one place. That's where the P-POD came from, the dispenser that you put the CubeSat into, that deploys it in space when you get into space. All that is handled separately and you just bring the thing to put into the P-POD. And that's what the CubeSat is. He had in mind, several one you, a one leader type things in each P-POD, but they ended up making satellites to fill them all up. So that's where that happened. I was involved with respect to the fact that I was at AMSAT when this was being thought about, and I knew the people, but I'm certainly not the inventor of any of that.

Eric, 4Z1UG:

Up until that point, up until Oscar 16... The AMSAT satellites were larger, maybe much larger. Right. And in order to get a ride up to space, they had to go as cargo or in unused portions of the vehicle?

Courtney, N5BF:

Yeah. Well, the way the story was told was that every launch has excess capacity. The paying customer has not used every kilogram that they could have. They've just done what they needed to, and then all the rocket parameters are adjusted to that. So it seemed a shame to the amateurs that all this excess capacity didn't have radios in it. Right. So the idea at AMSAT was to use as much of that as possible, but yeah, I mean, you ended up needing to know somebody, right? So the guys at AMSAT in the beginning, in the early '70s, they worked together, they were involved in launch operations for other things. They knew who they needed to talk to, to get something added on. And it was a much more open environment to that sort of thing back then than it is now.

Courtney, N5BF:

I mean, AMSAT really succeeded in creating the paradigm of small satellites that use up extra space so much so, that now launch providers charge millions of dollars, a lot more than AMSAT can afford to use that space. And so they were a big success. They run themselves out of business in the process of doing that.

Eric, 4Z1UG:

Let's go back to the copter. I've got a couple of copter questions that were sent to me. There's very good images of the copter. I actually just saw one tonight that was in a tent. So I got a sense of maybe how big the copter was. But for the listeners, how big was the Mars copter? The pictures we see there isn't anything to reference it in terms of compare it to.

Courtney, N5BF:

Right. So blades, there's four blades, two pairs, and they counter rotate, and that's how they maintain control. Those blades are 1.2 meters long and that dimension was set by the ride

we had to go to Mars. We had to stick this on the Rover. We came in late and they didn't have any place for this. And so it went on the bottom. And that's how much space you have, about four feet, to put something on the bottom. And so that defined how big the blade could be. And then from there, everything else... then the atmospheric density, the camber of the blade itself, then you could calculate what mass was available for the entire thing.

Courtney, N5BF:

So when you see that, it's about four feet and all the rest of it... the next biggest thing is the landing gear, which is just sticks that stick down toward the ground. And then the electronics is in a box about... I think it's about a six centimeter cube or something like that.

Eric, 4Z1UG:

And you said that the electronics... At least the radio package was in a Mylar box. The electronics for the copter, were they in a beautifully milled aluminum box or a plastic box? I mean, since weight is an issue, what can you put your electronics in that withstand the Martian environment?

Courtney, N5BF:

Yeah... Nothing. I mean, we built up all the electronics on five boards that were assembled around the battery, the battery holder, and the battery in there is the same size as six AAs. It actually uses vaping batteries because they have the discharge rate that's required to run the thing. But it's about like six AAs. It's about like a big flashlight. And then the boards go around that. And that is the structure. I look around my ham shack, I see that. I've got a board just sitting here, that just does something. It's just hooked up to something. It's just... and a wire running off and there's no box. There's no anything. That's...

Eric, 4Z1UG:

The assumption is it has a limited lifespan. So packaging is not the big deal.

Courtney, N5BF:

Right. By far, the biggest driving requirement was keep the mass down. And that meant that you didn't get to put systems in boxes and have interfaces. All the people actually had to work together to build circuits that were already together in that respect. The telecom board, for instance, the one I was most responsible for, it has a bunch of other stuff on it. It some... I don't even remember what it is, but it had other circuits for other purposes because... And we just had to work with those people and we had to.. And we would not ordinarily have, right? As the radio people, we would've delivered a box that was the radio and it had some connector on it. And then that would be it. But none of that here. We had to design one thing. That was the helicopter.

Eric, 4Z1UG:

And it may not have been beautiful. For the neurotic obsessive compulsives in the amateur radio hobby, if they looked under the hood, it might have looked like the back of many of the two meter repeaters we've seen in the past.

Courtney, N5BF:

Well, not exactly. I mean, by the time you build the one that's actually going to Mars, only four people are allowed to touch it and it had to be built to standards. So some of the stuff that we built on the way up to that was... ugly is not exactly the right word, but not built to look at, yes.

Eric, 4Z1UG:

You wouldn't use cable ties, nylon cable ties, and something like that because of the weight. Right. So you might use dental floss.

Courtney, N5BF:

Right. Because those out gas. Right. So you have all the standard materials' requirements and analysis and all that sort of thing.

Eric, 4Z1UG:

For space vehicles?

Courtney, N5BF:

Right.

Eric, 4Z1UG:

Let's change gears. I think that we've kind of gone through that. I think this is all fascinating. I'm writing terms here for the show notes that I've never heard before, but I'm anxious to actually put links to them. You're the current president of the San Bernardino Microwave Society. Could you talk a little bit about what the San Bernardino Microwave Society is and how important is this club to Amateur radio in the state of the art?

Courtney, N5BF:

Part of my story from the beginning. So I had this Homebrew transmitter, and that led me to the false belief that I could build anything and do anything with anything that I built, but at SBMS, San Bernardino Microwave Society, this is the place where people who are like that still get together and build things. Because when you get into the higher frequencies that are allocated to Amateurs, that isn't off the shelf... I mean, they're off shelf components, but to make a whole system that works for transmitting and receiving like Amateurs, well, you have to put something together and there's a certain minimum amount of building you have to do. And that's one of the motivations for me to be there. It's one of the things that SBMS contributes.

Eric, 4Z1UG:

When we're talking about frequencies above, I don't know, probably 400 MHz, is that what you would consider the 150 GHz?

Courtney, N5BF:

Yeah. The charter is communication above 1000 mega cycles.

Eric, 4Z1UG:

One GHz and above.

Courtney, N5BF:

Right. But we consider ourself to be a sister club with other organizations that are 50 MHz and have different things like that. But it's the ones that you don't think of as Amateur radio stereotypically. Right.

Eric, 4Z1UG:

Well, admittedly, there must be other Amateur radio microwave societies around North America. For some reason, I've had a preponderance of guests from California, and that's why perhaps San Bernardino Microwave Society comes up in the QSO Today Podcast. But it seems to me that a club like this would be actually on the cutting edge of technical development in terms of... because of the frequencies, because of maybe the availability now of parts that come from the cell phone business, and even the LiDARs on cars and things like that. Would you say that this is the place where the next generation of Amateur radio thinking is going to come from?

Courtney, N5BF:

Well, I would say that it is one of the places. This is certainly... SBMS basically stands for what I think of as the R&D. And in this case, kind of the radio frequency R&D part of Amateur radio. And that needs to be happening. And I would say a lot of what we do now and a lot of what we have done from the beginning, again, is repurposing things. Some of the guys at the beginning, they worked in systems that no one can talk about, there was these spare parts left over, things would find their way into Amateur rigs, be returned and repurposed to these Amateur communication test at the microwave frequencies. So yeah, in that respect and also there's things going on in digital signal processing, in digital communication that we're getting into, and so it is a cutting edge. It's not the only one, but it's certainly one of the technical areas that Amateur radio is leading currently.

Eric, 4Z1UG:

Does SBMs have any major projects on the board where members are working together towards accomplishing some end?

Courtney, N5BF:

Yeah. So we all recognize... When you go out to build a radio, you'll get to a point eventually where you need to have some way to know whether it works or not. And I had this experience when I built up my 10 GHz system that I use for 10 GHz SBMS related operating activity now. You get up to the point where you need to receive a signal and you could have a signal generator locally that makes something, but it's nice if it's something that someone else did, right. That you didn't have to... When you have your own signal generator and you're trying to see if your own receiver works and it doesn't, you don't know what doesn't work. But if you know that there's a Beacon on the air, like I live in a location here where I can optically see Palos Verdes, there's a 10 GHz Beacon over there.

Courtney, N5BF:

And when my receiver started receiving that, I knew that I was 60% of the way to having a radio that worked. So at SBMS, we all realize this because we've all been there. And we realized that having Beacons on the various microwave bands in various locations, where people who are working on rigs can hear them, or if you're trying to optimize your rig, or if you're trying to get the feed in the right place with respect to a parabola, or any of the many things that you could use the signal for, it'd be nice to just have that accessible. And there are several Beacons around the area that we can already use for this. Right now, they just send carriers most of the time and they identify in CW every minute or so, or few minutes.

Courtney, N5BF:

SBMS right now has a project where we are kind of upgrading that capability, instead of just CW and just carrier, we'll still do that, but we'll also send some of the JT modes so that you can get identifying information and so that you can see if the digital part of your radio is working just by listening to the Beacon. And it's a huge sense of accomplishment when you're building up something and you finally get a decode out of this radio that's never worked before, then you know that many things are now functioning.

Courtney, N5BF:

So having Beacons around that are sending things in various formats for people to use to bring up their systems... We are working on a design for that and we hope to make the design open source so that people worldwide, who agree with this approach, can set up their own Beacons to the same end.

Eric, 4Z1UG:

Now, are there reverse Beacons? If you want to test out your 10 GHz transmitter, other than having a ham up on a Hilltop or on Palos Verdes, is there some place that you can transmit to make sure that you're actually getting out and being heard?

Courtney, N5BF:

Yeah, there are such things. In Northern California, the 50 MHz and Up group there, has a system on Mt. Ellison that listens to you. I've been contesting up there and made use of this. You can point your transmitter at it, and it will listen, and it'll give you a signal report. And you can figure out what the signal port means. And you can adjust your aiming and your power level and so forth according to that. So there are things... there are Reverse Beacons.

Courtney, N5BF:

This is not in the planning stages at SBMS right now, but I will see that as... this is happening all over Amateur radio. I mean, people who are calling 40 meter nets are basically using internet receivers in other places to enhance their ability to hear who's trying to check in and that's the same kind of thing. Right? So this is happening and I think there will be more of that.

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.

Eric, 4Z1UG:

And now back to our QSO Today. Is there any direction in Amateur radio that you took that in retrospect, you might have taken a different path, like you're at a fork in the road and you've decided to go in a direction, looking back, would you have gone differently?

Courtney, N5BF:

The thing I like to say, this is just a personality thing, is that I wouldn't change anything. But the reason I say that is because...

PART 3 OF 4 ENDS [01:21:04]

Courtney, N5BF:

... wouldn't change anything. But the reason I say that is because where I am right now is pretty good. And if I changed something in the past that might not be like that, right? So I'm just kind of scared of the entropy. I can't really think of anything big. I mean, there's more things I would've done, but as we were discussing earlier, you have limited time and you basically have to prioritize. And I think my priority choices have been well, I give myself a B.

Eric, 4Z1UG:

So let's ask another question. Is there anything about amateur radio that you underestimated that became more significant than you thought originally? That's one of those that'll never work questions that turns out to be a gold mine.

Courtney, N5BF:

I've seen things work that I didn't think would. I'm trying to think of a concrete example. So, this isn't an exact answer to that question, but it is the thing that comes to mind but one of the things I was always interested in from the early days was the ability to use digital signal processing to get much further into what we think of as the noise than we were currently able to with existing modes.

Courtney, N5BF:

And so, Joe Taylor and his team, K1JT have really made that possible. I mean, this is exactly the way I would've wanted to see that go. And interestingly, he gets this. He reports the signal noise ratio as a negative number compared to what you would nominally need to do a side band contact, right?

Courtney, N5BF:

And so we're all making contacts at minus 25 and minus 30 DB from where side band would've been possible. And that's even 10 or 12 DB from where CW would be possible. And I

think there's more to be done. I think Joe and the team also think that, but there are more DBs to be fared it out by patient operators along those lines.

Courtney, N5BF:

And I think that's been a great thing and I'm glad that it has happened. And I'm kind of surprised that it happened actually, but that leads amateur radio into new regimes that need to be investigated. And, it's one of the things amateur radio is good at. It doesn't really have an obvious commercial value yet. And so we can sit around and have fun and do things beyond the previous limits. And maybe we'll find a real use or maybe we won't. I mean, it won't matter, but if we do, it'll be a contribution.

Eric, 4Z1UG:

This is obvious to the listeners and to you as well that the internet was originally created or the IP protocol was created to create this network that would be free from harm. Now we've created a trillion dollars plus, plus, plus of this internet infrastructure that we're using right now to communicate that's amazingly fragile.

Eric, 4Z1UG:

So it's very possible that maybe the default network will be back on HF using the Joe Taylor digital modes as a way for us to communicate that five pod in order to say I'm okay.

Courtney, N5BF:

That being the problem that, yes, it's great, but it's low bandwidth.

Eric, 4Z1UG:

It'll be what will survive when the whole house of cards collapses.

Courtney, N5BF:

Oh, right. Yes.

Eric, 4Z1UG:

I understand that you've played in the regulatory aspect of ham radio. Now I've been prompted, has the cooperation between hams and hams and hams and government matured for the benefit of the hobby and its members?

Courtney, N5BF:

So, I kind of consider my viewpoint on this as being a lay viewpoint, which I guess all hams are kind of layman in this area. But I think the relationship between hams and the government has been better in the past than it is now. I think what's happening now is that the government isn't hostile, it just is kind of ignoring us because we're not high bandwidth or we're not high revenue.

Courtney, N5BF:

And this is the thing I would say, I mean, hams, so I think one of the unique and remarkable things about amateur radio is that we have allocations at frequencies all over the place from a few hundred kilohertz up to lasers, right? And they go through the microwaves, they go about every factor or two or maybe one and a half through the short waves and so forth.

Courtney, N5BF:

And this really gives us an ability to, for lack of a really good term, just to self-educate about the differences in wavelengths and what that means. Anyone experienced in shortwave knows that 40 meters and 10 meters are very different things, even though they both use the Ionosphere.

Courtney, N5BF:

Well, three gigahertz and 10 gigahertz are very different things too. Partly because the spectral properties, partly because of the physics of the planet and the things that radio waves bounce off and so forth. I mean, it's just different. And the equipment is different. The way that you make power and use bandwidth at these different bands is different.

Courtney, N5BF:

And this is the thing you don't really appreciate if you're in, for instance, if you're in the cell phone business, you're only working at a few different frequency that are good for that and you might not be aware that there was anything at shortwave or at millimeter wave or whatever, but hams have the ability probably underappreciated to basically go someplace close to any frequency you can imagine and do something there.

Eric, 4Z1UG:

Do you think that we're doing a good enough job helping the unham, the uninitiated person who maybe not know anything about ham radio, what our value is in this respect?

Courtney, N5BF:

Well, I've thought about the differences between when I was new in the hobby and today, there was a time when hams were the only people who had communication in their cars besides law enforcement, and that's not true anymore. I mean, so many things like that where amateur radio was unique have kind of eroded away, but the ability to experiment, the access to frequencies for non-commercial uses to do things, to try things that may or may not work that were failure is an option.

Courtney, N5BF:

That's a thing that should be appreciated within the hobby and in society. Let's see. And I had another thought about this. You haven't asked the question yet, but in the vein of regulations and hams getting along with each other, I think the big issue today is that, especially in the microwaves, we're under huge contraction pressure. At 3.4 gigahertz, for instance, we're losing part of that band and there was a thought that, for a while that we would lose the whole thing.

Courtney, N5BF:

But right now kind of looks like it's stabilized with we're retaining 75% of the bandwidth that we had there. Well, so that puts a lot of pressure on existing infrastructure inside the hobby that leads to a lot of heat where really, in order to survive, the hams need to come together and present a unified front against the pressures of contraction.

Courtney, N5BF:

And we need to cooperate with each other, just use what we have to the best of our ability rather than self destruct under this pressure, right? So, that's a warning note, I think. And I think if you look at it globally, I think that would make sense to anybody that we just need to come together and cooperate internally and make filings whenever they come up.

Eric, 4Z1UG:

Look, I think that was going to be one of my questions, obviously, at least in California and perhaps in other major cities in America, the three gigahertz band is being used by Arden and maybe organizations like Arden, but I think Arden was what comes to mind.

Eric, 4Z1UG:

And it seems to me, well, here in Israel, it's not being used at all. In fact, the 450 band, I just noticed next to my repeater, 15 kilohertz away is probably an illegal DMR repeater that's running some taxi cab out where I live, so unless we use these bands and unless we let people know who are not in amateur radio, that we're using these bands and that these networks have perhaps public safety value or public service value, we stand to lose the spectrum because it's very valuable, as you were saying before.

Eric, 4Z1UG:

The cellular telephone interest will pay millions of dollars for access to the frequencies that we have. So it's an interesting problem. And I'm just thinking that maybe we're just not tooting our horn loud enough in terms of the spectrum that we're using and the benefits that we're creating from our failures. What do you think about that?

Courtney, N5BF:

Well, I think we do make contributions. I mean, we've discussed many of them and we do need those contributions to be publicly known more than they are. I think that's a big thing that could help. And when you mention Israel, I think of 4X1AJ, he's a guy on 1296 Moon Bounce. And I'm trying to remember if it was this year or late last year when Israel lost that frequency for Moon Bounce.

Courtney, N5BF:

I mean, I think he's still allowed to transmit 10 Watts or something, but I had just worked him hen the news came out that they're only allowed to use 1260 to 1270 or something now. I mean, this is happening. Hardly a week goes by when you don't see some threat to some band or the portion of some band or some use of some band, in part, because-

Eric, 4Z1UG:

Nobody knows we're using it perhaps.

Courtney, N5BF:

Yeah, because nobody knows we're there. Right.

Eric, 4Z1UG:

That's right. I think in France last year, they could have lost one or two megs of the two meter band, which would've been the whole two meter band, so that somehow was put to rest. But I think that, especially in countries like Israel, where our numbers seem to be diminishing rather than increasing this spectrum that we have is in danger of being taken over and used by someone else.

Courtney, N5BF:

Well, and so some of the defensive things we can do, anything from stop gap measures like, I've been in organizations that said, anything you have on the air, you should mention that on the internet so that when someone does an internet search and see what's going on 3.4 or 10.368 or whatever, they'll find that.

Courtney, N5BF:

And then they'll say, look, somebody's here doing something. Well, let's look someplace else, maybe. I mean, that's the hope, right? And another thing you want to do you want to imagine someone somewhere in the Los Angeles basin, turning on a spectrum analyzer and looking at one to 20 gigahertz to see if there's any open space there?

Courtney, N5BF:

Well, the ham bands ought to have something in them, so they'll see something going on there. And I think a lot of this is happening, but these are just things we should be keeping in mind as we do our projects. We should also get the word out there that it's happening so that people will know.

Eric, 4Z1UG:

What innovations in technology can we use now to update the amateur use of the microwave bands in addition to the new beacons?

Courtney, N5BF:

Well, so like I was saying, I mean, I like to tell people that I wouldn't be in moon bands if it wasn't for the digital modes, the JT modes and basically what they do, instead of using three kilo Hertz or a few hundred Hertz for CW, they're basically using a few Hertz for each tone that they're looking for.

Courtney, N5BF:

And so they basically just narrowed down the bandwidth of what you're trying to detect, and that allows you to go a lot for further with a smaller station than you could have before. So this allowed me to put a station on the air that could make a reasonable number of contacts. And once I was there, then sure, I got up on CW and worked the guys too, but I wouldn't have done it just for that, right?

Courtney, N5BF:

So, that's one thing, we can be used modes like that, lower bandwidth to extend our range and capability, but that's just my own preferred way to advance. There's other things that ought to be going on too, such as Arden where they're basically providing not exactly, but something similar to internet capability, but all hosted with in amateur radio.

Courtney, N5BF:

And it's a large bandwidth that you would see on a spectrum analyzer and so forth. And the whole business is basically gone digital already. I mean, I'm not against analog modes and I use them and I enjoy them, but we have to be digital with everybody else.

Courtney, N5BF:

And that will enable things, as we say, closer to the Shannon limit than what we have traditionally done. And that's a place where we should be because we have to be there in order to be conversant with everybody else.

Eric, 4Z1UG:

In your opinion, how should we move forward as an amateur radio community to make it more relevant and interesting to the general population or maybe to young people?

Courtney, N5BF:

The question for young people is particularly interesting. I think I don't really have the answer to this, but I am getting feedback that indicates to me that we have to do what a lot of businesses are doing. We have to think in terms of how different generations of people think and process the world and tailor some of what we in that direction.

Courtney, N5BF:

As a guy in his 60s, I think of this as younger people have lower attention span, just because of the way they've been trained by technology. And so, we need to have outreach in that direction that is tailored to a lower attention span, which I don't think is hard to do. I think it's just a thing that you have to realize while you're trying to do it.

Courtney, N5BF:

Now, that said, I think that there is still a core of people who are interested not just in radios for what they do, but for how they work. And we need to find those people and get them excited about learning the craft, understanding what's going on in there. Those people are there. We just need to invigorate them.

Eric, 4Z1UG:

Did you find at JPL that the younger people that were coming through Caltech had these kinds of interests? I mean, perhaps, that was an ivory tower that just attracted young people that would have an interest in radio and communications, but did you find that, that was the case that you actually had those people coming through?

Courtney, N5BF:

The short answer to that is yes. Having worked in fly radios at JPL, I worked with people who just don't get this at all, all the way up to people who carry around HTs on their belt that are tuned to the local repeater and just can't imagine not doing that. And so those people, and they are in a higher percentage of JPL because that's the kind of person who you would find here.

Eric, 4Z1UG:

So, I guess we have to figure out how to do amateur radio for the rest of us who are not at Caltech. That always seems to be the question.

Courtney, N5BF:

Well, one of the interesting things about amateur radio is that we have all these people who can be involved in various kinds of experiments. And again, I think of the Arden example where, their approach has been to repurpose existing equipment, make it cheap enough for people to set up at their own homes.

Courtney, N5BF:

And people set up these nodes without really knowing in depth what it's going to be or being big users of it, but they just set them up because they can, because it's within a certain cost and technical complexity range. And so I think there's a lot of room to use broad, generalized amateurs in that kind of way.

Courtney, N5BF:

It's not the only way. I mean, you don't find me of people like that at SBMS. These are the hardcore people who do soldering and find the latest technology and incorporate it into some project of theirs. And that also is a valuable thing that needs to be happening. But I don't think any of this needs to be exclusive just to people who are communications engineers, for example.

Eric, 4Z1UG:

What do you think the greatest challenge is facing amateur radio now?

Courtney, N5BF:

Oh, it's really what we've talked about, that ...

Eric, 4Z1UG:

Spectrum defense, right?

Courtney, N5BF:

Yeah, the whole world is caught on to the magic of wireless in a way that only 1% of the people understood in the 70s and even subconsciously, I mean, people don't realize that cell phones are radios, they just know that they are boxes that they carry around in their pocket to do everything.

Courtney, N5BF:

And the whole world is putting a lot of pressure on what is an advocational pursuit of a small percentage of people. And that's a major threat that we have to fully understand and be prepared to address. I don't think amateur radio will ever completely disappear, but I think in the distant future, the allocations for it will be smaller.

Courtney, N5BF:

And we may get into white space land where people don't have ... that there'd be regions of the spectrum that don't even have allocations anymore kind of like the ISM is now, but you just go on where there's no one there in some automatically coordinated, pseudo, friendly way and use whatever's available right here right now.

Courtney, N5BF:

And we need to be aware that, that's happening and that we may end up participating that way. So, I think there'll always be an advocational aspect in radio, and it's value to society needs to be appreciated.

Eric, 4Z1UG:

What excites you the most about amateur radio now?

Courtney, N5BF:

Oh, well, it's basically, I mean, I'm a guy who went to JPL because we're sending stuff beyond Neptune, right? The ability to have and still be in touch with equipment that's a light day away is pretty awesome actually.

Eric, 4Z1UG:

And you know how it works too, and it still makes your hair stand up on end. It's still fascinating.

Courtney, N5BF:

So, I was always patient enough to one bit per second, just detection at all is cool to me personally. I know that's not everyone's cup of tea. If you're standing out at the site of a big traffic accident, trying to help with your two meter or 440 radio, just detection is not going to cut it, right?

Courtney, N5BF:

You want a fairly reliable way to talk to someone who's fairly useful. And amateur radio certainly does that pretty well too in other areas. But for me personally, just detection of something that's a long way away and hard to get is pretty cool.

Eric, 4Z1UG:

Do you have advice that you give to newer returning hams?

Courtney, N5BF:

Yeah. This is funny. I was in an elevator one day at JPL on the way to work with my QST and a guy got on the elevator and saw the QST and he knew what it was. And he says, "Gosh, does amateur radio still exist?" And I thought, you know ... So, for newer returning hams, I would say you, yes, amateur radio exists.

Courtney, N5BF:

It's a place where if you're interested in and fascinated by what we call big R radio, not only the technology, but just the physics of it, how things work, the systems of it, this is a place where you can go, you can get a license that would allow you to emit radiation in certain controlled ways, you understand what you're doing, and we'll let you fool around, but within the restrictions that we have, the power limits, the bandwidth limits and so forth, you're allowed to kind of do what you want to, whether that's meaningful or not, and whether that leads anywhere or not.

Courtney, N5BF:

I see returning hams who, that realization is basically what brought them back. And I think that I would also say that to new hams.

Eric, 4Z1UG:

Before we wrap it up, Courtney is there anything that we didn't talk about that you'd like to make a statement or you'd like to mention before we go?

Courtney, N5BF:

There was one thing in the introductory comment that I wanted to make sure got in there, and that is the time we live in. So, I talked about how as a little kid I went down to the train station, and when you think about trains on the North American continent or in the world for that matter, this is one of the great technological innovations of mankind that enabled so much of the world that we have today.

Courtney, N5BF:

By being able to go down to the train station and talk to a guy who worked there and see him operate American Morse on landline, I was kind of witnessing the end of the golden era of that. And then, as I moved forward in life and my career, I've been at the, basically the birth of the space age, where we are leaving the planet.

Courtney, N5BF:

And the other thing I'd say about that, anyone who I've ever interviewed for a job has heard me tell this story and I say, when HG Wells wrote about a trip to the moon, his concept was that a bunch of people would get in a capsule and be fired off to the moon. And then they would live to return to the earth, and then they would publish papers that would be read at the Royal Society, and that's how we would know anything about space.

Courtney, N5BF:

But the invention of radio changed all of that. We don't have to send people and they don't have to survive to come back and write papers. We can talk to our boxes that are a light day

away in a couple of days. And we can still get the information from them, even though they've been flying for decades now.

Courtney, N5BF:

So the ability to use radio to move into remote locations and back has really revolutionized everything about humanity. And here we are. I can't imagine that there wouldn't be an advocation where that was happening and that there wouldn't be some people who were pretty excited about it.

Eric, 4Z1UG:

I am so grateful that you agreed to speak with me on the QSO Today podcast, Courtney, it has really been a lot of fun, and obviously we've gone over the normal time, but I knew that we would, and I'm so grateful that you agreed to speak with me and to speak this long. So with that, I want to thank you so much and wish you seven three.

Courtney, N5BF:

Well, seven three.

Eric, 4Z1UG:

That concludes this episode of QSO Today. I hope that you enjoyed this QSO with Courtney. 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 N5BF in the search box at the of the page. My thanks to ICOM America for its support of the QSO Today podcast.

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