NORMAN ABRAMSON (NA) INTERVIEW
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INTERVIEWER: Dr. LEONARD KLEINROCK (LK)

LK: Why don't we begin simply by you giving us your name, and a very short introduction as to where your career has been, just in a few sentences?

NA: Sure, I'm Norm Abramson. My career is been all over the place. Started with degreees at Harvard. U.C.L.A., a school you know, Len, and Stanford for the Ph D. And I then left Stanford after about eight or nine years there...ten years there and went to the University of Hawaii and I had a great thirty years of surfing and doing networks at the University of Hawaii.

LK: So, over that period, did you receive any ARPA funding, and if so, in which periods?

NA: We very definitely did at the University of Hawaii. And the reason we did is that I had some initial contacts with ARPA. But the broader Department of Defense instituted a program that maybe turned sort of a as a development program for developing research universities. And this was in...uh...Oh the late 1960s. And at that time, just having moved to the University of Hawaii, I was located in just such a developing University and so we wrote a proposal with Wes Peterson and Frank Kuo and Bharat Kinariwala. And we sent it into this broad. D.O.D.. Program for developing universities, and th the proposal was indeed selected. And the agency that was within D.O.D., the agency that was selected to monitor that program was ARPA.

LK: So you approached them, it wasn't a response to a request?

NA: It was in response to a request, but not an ARPA request it was a very broad, multimillion dollar program within the D.O.D. in general and ARPA was just an agency within D.O.D. which was tasked with monitoring our project.

LK: So what was the project, and with whom did you interact at ARPA?

NA: Well that's pretty easy. The project was called the ALOHA Project, at the University of Hawaii that seemed natural. And the project had a one basic idea which, as all good programs do, morphed as time went by to include other ideas. But the basic idea was to connect computers. Which was done...whenever it was done in those days by inadequate telephone lines... but to connect computers by radio, rather than wires and uh... This was somewhat outlandish in many circles. But we thought it made sense especially for D.O.D. which of course doesn't have wires wherever it wants to go but it does have radios. There was a second part of your question…I missed it?

LK: The question was, was it ARPA funding that you got at the time, and who were the people you interacted with?

NA: Oh yeah, the people at ARPA, that's important. It was ARPA... It was not ARPA funding, it was D.O.D. funding monitored by ARPA. You can term that ARPA funding if you will. But what was important is that the key person in all of the first few years of the Aloha project was Larry Roberts. And Larry was... I have written this elsewhere...a remarkable person for...for his monitoring a project he knew how to do that very well. But more surprisingly, something I had never seen by any other contract monitored, Larry took a hand in the research of the project and he came up with some very important results. Technical results. And you look to Washington very often for funding, you don't look to Washington very often for technical results. This was an exception.

LK: Larry was brought to ARPA to basically create an ARPANET plan, so how was your ALOHA work related to any ongoing activities in the ARPANET planning, budgeting and communication?

The Arpanet plan was...as I recall it... and you were much more involved in this than I... but as I recall it, it was all a wired plan. It was connecting very large centers. An issue with not even connecting terminals, I believe. And connecting computers over long distances by wires. What we proposed was first of all radio connection for data and... It's hard to think of today when we all carry a little radio digital transmitter in our hip pockets. But there was no... there was no... there was no other system that had ever been built to connect computers, digital systems by radio, as far as I know. And so at the University of Hawaii, we built the ALOHANET. We connected terminals by radio and we extended that to satellite radio after a while and we were off and running, but we were never wired communication into any sort of digital system.

LK: So was the existence of the ARPANET thinking at that time, did that influence your proposing or investing the ALOHA architecture?

NA: It certainly did. The key thing was probably the use of packets within the ARPANET. And of course that was something which was invented in several places. With uh... in this country, Paul Baran, and in England and in France. But I don't believe it was ever implemented, until the ARPANET came into existence.

LK: So you talked about radio as very different medium than wired networks. Can you extrapolate on the differences and the way you exploited that medium?

NA: Well, that's one of those things that um... I think is quite illustrative of good research. We started out with simply the idea that radio was going to be used instead of wires. And also with the understanding that this could open up new ways of communicating new kinds of protocols and new methods of transmission. But we didn't understand a lot of the fundamentals that became available to us. Only after we had thought about this problem for a year or two. And there were some ideas that came out after a couple of years that were much more important in retrospect than simply the idea of using radio instead of wires. That was important but the idea that was more important I believe was the idea of random access by radio, that we developed, and that you developed at

U.C.L.A., also. And the use of random access channels for convenient access into a central location.

LK: When you were under the contract management at ARPA, did the funding come out of ARPA, or did it come out of the more general D.O.D. world?

NA: No, the more general. D.O.D. world, which by the way was called the Themis program T H E M I S, the Themis program provided funding for the first few years I don't recall maybe three or five years something like that but after that ARPA took us into the ARPA budget and continued our research on for a while and provided the support from ARPA rather than from D.O.D. more generally.

LK: You mentioned a few minutes ago, something about even satellite networking, so my general question is: There was the ALOHANET, there was the ARPANET, there was some satellite communications. How was the interactions among these networks managed? Were you involved in the network-to-network issues?

NA: We thought about the matter. But I would say in all fairness I think the really heavy duty thinking about them was carried on within ARPA and within the rest of the networking people at ARPA. We were always focused on the radio and the random access characteristic of what we had done. The interfacing of these various networks was not something that I or anybody else - with some exceptions - in our project, gave a lot of thought to. We did put together more than one satellite network and I believe we were the ones that suggested satellites to Larry and other people at at ARPA. But we didn't get involved in all of the deeper protocol problems of network to network transmission and communication…you know. And we had a program which did basically that but they were pretty simple. But no, I was not involved in that work in ARPA. We did the minimal that we had to do for the establishing the ALOHA network, to connect the ALOHA network to Arpanet, which was initially by cable, then by satellite. And for connecting the ALOHANET - and therefore the ARPANET - to a network that we developed with NASA throughout the Pacific area. All the way from Tokyo to Sydney, Australia then up to the University of Alaska.

LK: When you say connect to the ARPANET, what kind of a connection was that?

NA: Well, um… the best way I can answer that is that it was an effective, but very simple connection. We didn't get into the whole TCP/IP issues and that kind of stuff. We didn't get into broader protocols. In each of the two cases that we dealt with, namely connecting to the ARPANET, first by cable and then by satellite. And then connecting to what we call PACnet which was this international satellite network. We basically just connected and transferred packets among ourselves.

LK: Give me the time frame again on this, you mentioned late sixties earlier. Talk about the interaction with ARPA, the interaction with ARPANET in terms of possible use, more or less?

NA: To give you a really good answer to that, Len, I've got to remind us both that this is 2014. I don't remember things like that anymore, because I just go to the Internet. And it's all there on the internet. I you about your bunch of papers…you have a bunch of papers. And all the dates are out there and you can find them easily. So I find it hard to…I'm a little reluctant to specify dates because whatever I say, you'll find some place on the Internet that'll contradict me on that.

LK: That's true for everybody. So your focus was on multi-access. Were you thinking about multi-hop in your work with the ALOHANET?

NA: We did a little bit. But there are two ways to go to that. One is there are a lot of issues, multi-hop, where you go from a radio network which is just one hop in each direction, to something like the ARPANET and then the ARPANET to something which may take multiple hops. We didn't get involved in that. There is also the question of multiple hops within a radio network which is a much deeper question. And we did have some good students work on that, and I had done a little bit of stuff on that. And it is still from my point of view pretty much an open question, back in 2014. There's no really good solutions… there are solutions of course. But there are many companies whose graves litter the landscape today, that went out to build radio, multi-hop networks in ways which I could tell right away were not going to work. Some very talented people in those companies did that, and if you really work in this area a little bit you get an appreciation for some of the wrong things to do, some of which I saw vast amounts of money invested in. And there was no way I could stop it.

LK: And to make matters worse, there's the issue of mobility in a multi-hop. You were probably talking about fixed?

NA: So….well we were thinking about both and I had some sort of neat mathematical result of…but… Yeah, I would… both of them were things that we worked on, but I wouldn't say solved, in the ALOHA project, we chipped away at various pieces of it.

LK: Now you come from a long background of communication theory work, information theory, signaling, etc. How much did your earlier career in communications per se, impact your thinking that led to this ALOHA concept?

NA: Well, you know in some sense, everything we ever did impact everything else we ever will do. So I find it hard to answer that but I can give you a partial answer. My previous work was certainly all information theoretic stuff. Coding stuff. Signaling stuff. And signal detection. All of which was statistical…a statistical base, and I think the way I looked at communications was from that statistical base. And that was helpful for coming up with the solution that we in fact came up with in the ALOHANET. But one of the things that I know you realized and many other people noted too, was that our solution was a very simple solution. It was… turned out to be an important solution. But it did not go very deep into channels or communications. And perhaps that's why it was so successful. Because it was so simple.

LK: So, you've mentioned Larry Roberts as one point of contact in this ARPA community and now at some point you were ARPA funded. With whom did you collaborate or interact with in that community, vis-à-vis PMs and the IPTO?

If I remember the early days, when it all started it was a very… It was a very active and interactive and productive time. Because of the way Larry ran the various projects that he ran. We were only one of the projects, the U.C.L.A. and your project was another. But you know, I'm sure you remember there were lots of other very active projects, and what Larry did was he arranged these various meetings of subgroups of those projects. One of them was a packet radio group. Another was the satellite group. And we participated in all of those, and that participation was very important to us because we were…you know, I was stuck 2500 miles off the west coast of the mainland United States, in Hawaii. And it was a little difficult to get back and forth in those days…it was even difficult to make a phone call in those days. And the ability to interact with that group including yourself on a fairly regular basis was very important to our project, I'm sure. Much more important to us than to many of the good groups on the mainland, which had much easier access to each other than we did.

LK: So besides Larry, he was the main or the only person you interacted with within the ARPA community, ARPA management?

NA: At the beginning of the project…towards the end of the project, we interacted with others after Larry left, of course. But Larry was the guy who really got us going.

LK: Did ARPA, I guess in this case through Larry, impose any guidelines or determine the research objectives or deliverables? What was the nature of the… I'll use the word imposition or directives you received in terms of the flexibility you had in your research world?

NA: I never felt any sort of pressure to go one way or the other. We could always sit down and talk it over. And basically, once we had demonstrated that we could do things, we had the ALOHANET, that was working. And there was a lot of interest very quickly around the world in what we did from that point on. There was no… there was certainly was no question from ARPA what we were doing or why. We had pretty much carte blanche. The work that we did in that time was pretty much decided. It was decided certainly by me or even by the group of us that helped manage the ALOHA project. It was a sided with the. All of the people involved in these regular meetings Larry organized. And those were, we felt, crucial to determining the directions we wanted to go.

LK: In terms of the funding you got…how did you go about getting funding, what was the process you went through? You started with the THEMIS project and then you moved to ARPA…tell me what you had to do to get funding?

NA: Well, what we had to do to get funding was to convince the people who made the decisions back in Washington that we could be trusted to take whatever support that they could provide, and provide something in return. Sometimes people like to call these deliverables. That's a little bit too industrial for the academic setting, to be close to the truth. But we had to provide some evidence that we were making progress, that we were doing work that could potentially be important to the D.O.D., and that we could communicate those research results to the rest of the world to help make those research results important to D.O.D.. And of course, you know, we all also just mechanically, we then sat, after we had worked out all the ideas, we sat down and wrote a proposal and sent it in to Washington to did all that stuff, too.

LK: These were unsolicited proposals?

NA: I'm not sure….the…I'm not sure in many senses. I'm not sure whether it was unsolicited in the sense that the D.O.D. sent out a RFP and did all that stuff, or unsolicited in a sense with respect to actions on… with respect D.O.D. We talked to the people involved. They indicated that some ideas made sense and some didn't, then we talked about the ones that didn't and after all this was done, we went back and wrote a proposal on the basis of our discussions… and I don't know whether it was solicited. I know there is a technical meaning to that word, so the question is answerable. But I just don't remember that.

LK: So for how long a period would you be funded between these… preparing proposals for the next round of funding, was there an interval?

NA: I think the initial stuff from THEMIS was three years, and extendable by another couple of years after that, it was pretty much a year by year proposal, I think. There may have been some which were longer, but relatively short periods, but it didn't really concern us very much, because we were in close contact with the people who were doing the funding.

LK: Did you feel you were competing with other research groups with that funding you were seeking?

NA: Yes, and I thought we should be. We welcomed the competition, because that competition also gave us pretty good ideas on what was important. And getting off by ourselves and doing our research, I always felt was a dead end. I think to do important research, you have to talk to a lot of people including some people who don't agree with you.

LK: Now you were a P.I. at the University of Hawaii at this time, you obviously had people working with you, graduate students for sure, perhaps other faculty colleagues. What kind of a culture did you provide for them…did it mirror the culture that ARPA presented to you? Did you create your own culture there, what was the level of delegation, of direction, of constraints that you imposed on your research group?

NA: That one is an answer that is really colored by the fact that it was the University of Hawaii. We had come from Stanford and the department there which was a different culture than the University of Hawaii. And we

were working with MIT and SRI and other places and U.C.L.A. The University of Hawaii did not have the student resources that those other places had. I'm not saying that all of our students didn't measure up. There were a few small number of students who could have done very good work at any of those places. But we didn't have the vast pools that we had at Stanford. And that changed the way you manage this kind of a project there. You spent a lot of time finding those little gems among the colored glass that exists in terms of students. But you also spent a lot of time working, and understanding what's going on with the other groups that you're dealing with, so if this had been done at Stanford for example, I think it probably wouldn't have had as much effect, surprisingly. Because we made a real effort to get out there and talk to a lot of other people, whereas when we were at Stanford, I think you do your stuff and you expect the world to come to you. That didn't happen in Hawaii. Although there were Hawaiian advantages to having people come to us and lots of people picked up on that.

LK: So you mentioned group meetings, especially within packet radio group, satellite group…did you participate in any more general P.I. meetings? The basic question is, how much did the ability to interact with other principal investigators and researchers impact the work that you were doing?

NA: I think it was terribly important. Now I would be careful in trying to extract that it's some general principle for ARPA. I think that kind of interaction is good for everybody. It was much more important for us at the University of Hawaii, and it think it was important for the other groups too, but less so. Simply because of both our geographical distance and our academic distance from many of the other groups in ARPA's portfolio.

LK: Did you find people from areas outside radio, outside the networking community. whose ability to chat with them impacted or effected your thinking about the general problems you were researching. Was there an interdisciplinary impact?

NA: That when I made it a point in general to try to keep my interest a little wider than communications, just as on a personal level, I wanted that. But in terms of the project, I think that some other stuff that occurred in regulatory structures in, for example, the whole regulatory sequence which led to the frequencies assigned for things like WiFi and so forth, was the result of a guy…I don't… maybe you know? Mike Marcus, who was at the F.C.C. and he visited us, and we visited and try to figure out what he was doing and what he was trying to work out within the government. And that kind of interaction I thought was very important. It wasn't a purely technical, of course, it had a lot of regulatory, political and economic issues, which I didn't get into in my day job at the University of Hawaii. But I thought they were pretty interesting.

LK: Were you involved at all with the packet radio experiments in the San Francisco area, the van that would drive around with packet radios?

NA: I heard about that, I wasn't involved in it, because I think this was occurring as our project was exiting the ARPA portfolio…

LK: Year, roughly?

NA: Again, I don't know, but I believe it wasn't more than a year that we had some funding from ARPA, and that that stuff was going on, so I really wasn't very well connected to it. I knew the people, some of the people involved, but I did not get connected to that, and I think the meeting had somehow would sort of dribble off by that time, too.

LK: Now you mentioned some of the needs of the Department of the Defense. Were you made aware of, or were you expected to provide any applications to the military in the work you were doing, in what sense was the military needs and applications in your thinking, in your presence, that was explained to you by ARPA through their funding and their management process?

NA: You know, I believe the relevance to military applications was so obvious right from the beginning, that it never was a topic of much conversation between ARPA and myself, or any of the other people. When you talk about connecting computers by radio rather than by wire, it seems that the military, right away, is the first customer. So I think this was so obvious that nobody mentioned it, frankly. Now the the rest of that in terms of the other kinds of applications which came out of what we did…WiFi and…uh… 1G telephones and all the rest of that. That sort of just became very clear once we had started, and the fact that everybody didn't need pick it up…That has been the basis of a certain amount of disappointment… and the fact that some of us have had that… that we didn't patent any of the stuff. But I think that probably would not have been of very much use anyway.

LK: So, there were no specific, targeted applications to the military, that you were going after? There was this general sense, as you say?

Yeah, I don't believe they were. And certainly our project was always unclassified, we had no classified money. I was sorta useful because as you may remember, we started during the Vietnam era. And there were protests at the University of Hawaii as well as many other places, and we were able to deal with that very effectively, in a very open way, because we were not classified. And that really saved our goose on at least one occasion.

LK: So, Larry left while you were being funded by ARPA?

NA: Yes.

LK: So do you remember who you interacted with after Larry?

You know I think it was Bob Kahn, and that may have lasted a couple of years. I really don't remember the amount of time that that involved.

LK: So this is a general question. Can you describe the ARPA funding culture of that period in which you were funded? Can you characterize it somehow?

NA: You want me to summarize Arpa in one word or…?

LK: Not ARPA, but the funding culture and how you interacted with the researchers…

NA: Yeah, well first of all, that was changing. There were several different funding cultures depending on who was involved, and the culture that existed at the agency, I think it also changed at the top… at the level above Larry. But Larry always provided a pretty good umbrella. I didn't want to get involved in that. And I didn't, and Larry was always there as Larry, rather than… I didn't… I didn't have to work with anybody at a level where things were perhaps fermenting a little more than I would like. And the rest of that really didn't involve us very much. Maybe we were nicely separated. We were involved a little, of course, but we were separated by what, five thousand miles from Washington, in a time when five thousand miles was a lot of miles. And email had just been started by Larry, and the communication was nowhere near where it is today. So we were…I would say we were sheltered very nicely.

LK: So there you were in Hawaii, receiving this funding from ARPA…What was the nature of…I'm trying to characterize what you saw as a P.I., as it might appear today or in other periods in your career. Was there something that characterized the ARPA funding culture? Was Larry the unique entity that you didn't see at the time? That kind of question..

NA: Yeah, and we had other agencies providing funding, as well as companies. But first of all, you know, Larry was indeed unique for many of the reasons that we talked about here. The ARPA funding was also different from most other funding from Washington and from the commercial organizations that we dealt with in one respect, which was very important. Namely, it was big. ARPA grants were usually bigger than other research grants and let you do things in a more independent way than other grants. I probably shouldn't say that… we had independence for example for our grants from N.S.F., but they were small grants and N.S.F. had nowhere near the funding for us that ARPA did. But they did have continuous funding, long-term funding and they were very helpful.

LK: Could you describe what the ideal, we call them program managers, in your case it might have been IPTO director, Larry, the chief scientist, anyway… What the ideal characteristics of such a person interfacing the funding organization to the researcher, what that characteristic would be, how they would provide the interaction?

NA: I think, like in research in general, there are two aspects to answering your question. One is the administrative, financial aspect. And Larry was good at it, very good at it, actually, surprisingly good at it. But lots of other people are pretty good at it. The other aspect, though that we, again, touched upon is the fact that Larry was technically very involved. Now, monitoring of research contracts always requires somebody who gets somehow technically involved, and you can do that, even if you

never get involved in the guts of the project by doing research. Larry, for us, was unique in that he got involved in our research and I'm sure that Larry didn't do that in all of his projects, it would have been impossible for any one person to do that - we were lucky. What we were doing happened to interest Larry, and so he was not just a contract monitor he was somebody who was basically interested in the technical content of what we were doing. And that's why he got involved in our research. It'd be nice if all contract monitors could do that, but that's clearly impractical. A certain degree of understanding of the technical content is desirable, and I think by and large we got that from other organizations as well. Never though, did we get the kind of immersion that we got from Larry and ARPA under Larry.

LK: It's clear that ARPA was very successful during this period we're discussing, there was a number of wonderful technologies, maybe we should call them breakthroughs, but certainly developments. Can you characterize why that period produced so many great successes?

NA: You know I've noticed what you've just mentioned too, and I've talked to other people about it. I don't know if you were there, but when we first got our funding from ARPA, Larry asked us to organize a meeting in Hawaii. Of the..of all various contracts..were you in on that one, Len?

LK: Not sure which period you're talking about?

It was really early, it must have been…it must have been '67…

LK: There was a planning meeting…[inaudible]

NA: Oh OK. And it was one large one, where I organized. Meetings at the East West Center at the University of Hawaii. We had a large group and some pretty fancy digs and it was the typical, technical meeting. But anyway the people who presented at that, I started to think about it… And I talked to some other people about this…Well first of all… there was one of the co-inventors of this…this is a long time ago… one of the co-inventors of the BASIC programming language, Tom Kurtz, I believe. Secondly there was some guy from the a good college in the Midwest, his name completely escapes me, who was doing something really far out in flat screen displays. Then there was a …oh, let's see…there was another one. There were three or four projects that were just starting, which had major impact on the world. Including, I'd like to say, the ALOHA Project. And we all got up and gave our little talks at that meeting. But I've never been at a meeting where so many just…basic beginnings of so many important things were brought out, when they were still at the stage where most people say: "All at the really neat but that's never going to occur." So many of those kinds of technical things came out and that was, I would say, the most exciting technical meeting I was ever in on in anything. And it was an ARPA meeting held at the University of Hawaii.

LK: These projects were ARPA-funded?

NA: Oh yeah, every one of them, and I'm trying to think what some of the others were, but I think there were three or four of these things which we all, you know, we all have flat screens now. Nobody even thought that

was possible for decades in those days. We're all doing packet radio now and the BASIC programming language was in fact the start of some really serious work in programming languages. And uh, it was very good. It was a very good meeting that they had.

LK: I'm not sure if you can answer this, but do you sense that kind of environment exists today?

NA: If it did, I'd like to like to join it! But I'm not immersed in that stuff anymore. And I hope it exists today, I think it could exist today. And maybe it exists in some of the really exciting startups in a very narrow sense. But this…with this existed, in a very wide sense, everything from flat screen T.V.'s to flat screen displays to programming languages to wireless access to computers. That's a wide range of topics and I don't know that that exist anywhere today, I hope it does.

LK: Is there anything else you would like to elaborate on, or any topics that we missed that you'd like to discuss?

NA: No, I think you pretty much covered everything, and if I think of anything, I'll send you an email! You can do that now.

LK: Norm, thank you very much.

NA: Okay.