Speaker 1:   Greetings, welcome back to the second half of the program. In the first half you've got a glance of the 1968 demo and the team and the effort behind it. For the second half we're going to set Doug's work in a broader context and get some different perspectives from different people, not all of whom participated directly in the event.

Speaker 1:   Our next conversation is a ... Our next session is a conversation between John Markoff, senior writer for the New York Times who frequently, faithfully and fluently reports on information technology and innovations, and Bob Taylor. Bob was active everywhere in the surround of today's story. Trained as a psychologist, he followed JCR Licklider as Director of the Information Processing Techniques Office at our ARPA the Advance Research Project's Agency; in this capacity he not only championed interactive computing, but he also funded Doug's work. He went on to found the Computer Science Laboratory at Xerox Park, where his lab pursued another thread of this story, The Networked Personal Computer. Please welcome, John and Bob.

John Markoff: Hi everyone. Can I be heard in the back? Is this loud enough? Great. I wanted to start with a personal introduction about Bob's work, because Bob was the first major funder of Doug's work as a young NASA program officer. In the 1960s he funded the work that would become the mouse, something that I think it took NASA a long time to realize that they had funded and created. He then funded Doug's work on the online system when he had moved on to ARPA, which was the predecessor to today's DARPA, and he was at the Information Processing Techniques Office, which made the online system possible. He then conceived of, and funded, the ARPA Net. We talk about how many fathers the internet has, and I would like to make the case that this is the father that matters.

John Markoff: He then funded the demo, and thought of and funded the demo, and then later at Park he funded Alto. That's just a breathtaking string of getting it right so many times. He wasn't just a program manager, he wasn't just a bureaucrat, he was someone who was a visionary and his own right, and I would just commend you all to go to his paper that he wrote with JCR Licklider. I appeared in 68, I guess you wrote it in 1967. The Computers of Communications Device. That is getting it in a really big way. He was there first, and that paper stands up very well. Go read, it's easy to do because it's on the web, go read the last couple pages where outlines what is sort of the model of the modern internet. They have a wonderful description of something we don't have yet, an intelligent agent, in that paper as well. It's all there, and it's sort of a stunning decade. What a long, strange trip it's been, to coin a phrase.

John Markoff: Maybe we could start by talking about computing in the 60s. What was going on then, and my sense is that you were quite alone. Now everybody gets it, but then perhaps nobody got it. What was the ... When you came to NASA as a program manager, what were you trying to do?

Bob Taylor: Thank you for those nice words, John. I want to thank SRI for inviting me to this event.

Bob Taylor:	In 1960, I read a paper written by JCR Licklider on the IEEE Transactions. The name of the paper was, "Man Computers and Biosis," and it opened my eyes to what a computer could do, or be. When I was in graduate school I had a thesis to do, and I had to compute a multi-dimensional analysis of variance and I went to the computer center to get their help and they told me about punching holes in cards. I couldn't believe it, that I was going to have to sit at a key punch machine, and punch this deck of cards, then I'd take the cards to the computer operator who would tell me, okay come back tomorrow or whatever. I would go back and find out that in card number 631 I had mistyped something, and so the program had stopped, and I had to go fix up the cards and go through this process once again. It just seemed insane to me. I don't know why.
Bob Taylor:	A couple or years or so later, after reading this paper ... Licklider liked to be Lick. He outlined what a partnership between a properly designed interactive computer and a human being could really be. A couple years after read it I found myself as a program manager at NASA headquarters in their office of Adventure, Search, and Technology and unsolicited proposals would come across my desk. There was this proposal called Augmenting the Human Intellect by someone at SRI whom I had never heard of. I loved the idea in this proposal, so I got in touch with this chap and he came to see me in D.C. and we got him started on a NASA contract, which was quite a bit larger funding then he had had previously. It kind of got him and his group off the ground.
Bob Taylor:	Then, maybe a year or two later, Licklider came to ARPA and started ARPA's computer research program, while I was still at NASA. Licklider and I became acquainted and I told him about Engelbart, and he began to fund Engelbart as well. Then later, when I went to ARPA I increased the funding again. From about 62 to 69 I was involved with Doug and his work. Now, the amazing thing, one amazing thing, about all this ... John asked about what was computing like in those days. Computing was, in those days, believed to be for arithmetic and that's it, data processing, numbers, calculating payrolls, calculating ballistic missile trajectories, numbers. I wasn't interested in numbers and neither was Doug, and it was clear from reading this proposal. Furthermore, Doug and his group were able to take off the shelf computer hardware and transform what you could do with it through software.
Bob Taylor:	Now, software is much more difficult for people, generally, to understand than hardware. Hardware you can pick it up, and touch it, and feel it, and see what it looks like, and weight it, and so on. Software is much more mysterious, and it's true that Doug's group did some hardware innovation, which you all know about, but their software innovation was truly remarkable. I'm reminded of a story, I don't know ... It's probably not true, but NASA was evaluating the weight requirements for one of its manned space vehicles, and they were going around to subcontractors who were furnishing the equipment, and they said we have to know how much a computer weighs.
Bob Taylor:	So, they were taken over to where the computer was and they weighed it ... Fine. Then they said, well, what about the software? How much does that

weigh? They were told the software doesn't weight anything. The fellow didn't believe him. He went away but he came back a couple days later, and he was very angry. He said, you didn't tell me the truth. I looked into this software in quest and they showed me boxes that were very heavy. They had cards in them with holes punched in them. He said, that's the software. He was told, well no, the software is in the holes.

John Markoff: How much of a gamble was it? Do you remember Doug as being someone who was out in left field in terms of existing computer science when you funded him? Did you have any of that sense? I continually hear this notion that what the perception of what Doug was doing, office automation, but real men did artificial intelligence. Were you swimming up stream in any way when you-

Bob Taylor: Yes, but it's all relative in some sense because even the computer establishment in those days was dedicated to batch processing. ARPA, it's true that a few people under ARPA sponsorship were beginning to develop timesharing, which would give you interactive computing, but at the computer conferences, for example, like the full joint computer conferences held every fall on the west coast, and the spring joint computer conferences held in the spring on the east coast; there's always, at these conferences, panel discussions attacking timesharing and attacking the idea of interactive computing. The reasons were multi-genius. They'd say, well it's too expensive, computer time is worth more than human time, it'll never work, it's a pipe dream.

Bob Taylor: The great majority of the public, including the computing establishment were not only ignorant and would be opposed to what Doug was trying to do, they were also opposed to the whole idea of interactive computing. Then, a few years later in 1966 I started a project at ARPA called the ARPA Net, which came online in 1969. About 1967, I invited IBM to join this to be held experiment as a node in the ARPA Net. They said, we're not interested, our computers can already talk to each other.

John Markoff: That was something you fought beyond IBM, right? Individual researchers within the ARPA community were [inaudible 00:12:21].

Bob Taylor: I'll get to that.

John Markoff: Okay.

Bob Taylor: I went to AT&T Bell Labs and I said, I'd like for you to become a node on this network and it won't cost you anything, it's going to be the first interactive computer network. They looked into some of the specs, and they said packet switching won't work. We're not interested. So, it's very nice 40 years later to see Doug and all the work properly rewarded. At SRI in those days, Doug was also having problems. His manager, early on in the NASA support, came to see me, which was unusual. Came to see me in my office in Washington, and he said I want to talk to you about Doug. He said, why are you funding him? I said,

because he's trying to do something that's very important and that nobody else is trying to do, and I believe in it. I got the sense that this fellow felt that Doug was ethereal in some fashion or another, and he wanted to see if his funding source was also ethereal; because if the funding source disappeared, well then the manager would be in trouble.

Bob Taylor: So, I did the best I could to make a good sales pitch as to why he should support Doug and it worked out okay. There were obstacles of all sorts, and did I feel alone? Yes. The few people who were working on interactive computing, or the ARPA Net, or the augment system, also felt alone. Even within that, the community of people who were doing work on interactive computing, there was probably a pecking order of some sort, there always is. Doug's group, at that time, before this demo, was probably at the bottom of that pecking order. That's just the way it was folks, it was very frustrating. Doug and I talked about doing this demo in early 68, and I was strongly encouraging Doug to do it. He said, it's going to cost a fortune. He said, we're going to bring in this huge display, and we're going to have online support between San Fransisco and Menlo Park, it's going to cost a ton of money. I said, don't worry about it, ARPA will pay for it.

Bob Taylor: A year or two after this demo, which was as you know a marvelous success, Doug told me a story that I hadn't known about until he told me. He said there was a contracting officer, government contracts have people who work for the government who are local to the contractors place who come around and check on the expenditures to make sure they're spending the governments properly and so on. He said, a contracting officer ... Doug was telling me this, came to me before the demo, sometime before the demo, and had seen the budget numbers for this demo, and he asked what was this all about. Doug told him, and the contracting officer just shook his head in disbelief, and he said, if this thing comes off, I'm going to deny knowing anything about it.

John Markoff: Collective intelligence has become quite the buzzword. Google's page rank, algorithm is probably the best example of the fact that you can actually make money off of this big time. Doug came to you with a proposal that had both an aspect of collective intelligence, and it had an aspect of interface, sort of changing the nature of the way we talk to computers. Were you attracted by both right from the start? I'm asking because I have this sense that you understood the importance of community early on, and whether you saw that aspect in Doug's research right from the start.

Bob Taylor: I think the thing that I was most attracted to was the fact that he was going to use computers in a way that people had not. To, as he put it, augment human intellect. That's about a succinct a phrase as I can think of to describe it. He was interested in knowledge. He was interested in sifting knowledge, and categorizing knowledge, and he was interested in cooperative editing, cooperative composition. These kinds of things were more interesting to me than the nature of the interface at that time. I mean, the interface was a normal television set, the mouse of course and the keyboard were innovations, but the

television set wasn't. The television set, as you saw, was driving by a camera looking at a [inaudible 00:18:15] that was generated by the computer. Your analog to digital conversion was a camera looking at a tube, and it worked marvelously.

John Markoff: That's the very definition of Rube Goldberg, I believe.

Bob Taylor: Yeah, right. Bill English is the miracle working of most of that sort of thing.

John Markoff: I wanted you to tell one story, I want to ask you several stories, but the one story that really struck me is how the obviousness of the idea of the ARPA Net came to you. I believe it happened when you took your new job at IPTO. Can you tell that story? Because it speaks to where innovation comes from, I think.

Bob Taylor: Okay, well prior to my going from NASA to ARPA, Licklider had started this program at ARPA in 62, and Ivan Sutherland has succeeded him in 64, I believe. Then Ivan hired me as his deputy in 65, and then Ivan left, and I was left in charge. Now, Lick had earlier started research funding at UC Berkeley, System Development Corporation in Santa Monica, California, and Project Mac at MIT, and all these three places had experimental timesharing systems that were being built by ARPA support. They all three had terminals in my offices in ARPA. If I wanted to log on to one of those systems, I would go sit at the terminal for that system. If I wanted to log on to another system, I would get up from that terminal and go over to another terminal, and sit and do the same thing. But of course different command languages for different systems.

Bob Taylor: Well, any idiot would see that this is silly. I don't have on terminal and have it connect to whatever system it's capable of connecting to. That was one motivation, but there were others. I visited these places that we were funding frequently, and I would talk to the people who were doing research there. I would often run into a set of interests at one place that were shared by someone, or two, or three people at another place, and again at another place. Well, why can't these folks share interests on a common network? Also, a no brainer. So, we did something we hadn't done previously, and that is we initiated a piece of research, rather than respond to an unsolicited proposal, which is what we had normally done. That project was the ARPA Net.

John Markoff: Now, you didn't talk about the resistance from the ARPA community to the ARPA Net. There was ... It was not an easy sell, right?

Bob Taylor: That's right. In fact, it goes back to something that was said before the break. Someone asked a question about Doug and the network information center, which served the ARPA Net. In 1967 ... Let me back up. Every year I would, and Ivan before me, and Lick before him, would have an annual contractors meeting where the principle investigators of all the contractors would come and meet for a day or two retreat. I like to have these meetings at attractive places; like we had one in New Orleans during Mardi Gras, we had one at the ski lodge in

Salt Lake City during skiing season, we had one at the University of Hawaii in the winter time. The agendas for those meetings were we'd work in the morning, we would play in the afternoon, and we would work at night, so we could take advantage of whatever was there. Well, in New Orleans I think we played at night, and worked in the day time.

Bob Taylor: Now, at one of these meetings in 1967, I announced for the first time to the group of contractors assembled that we were going to start this ARPA Net research program, in fact we had already started it, but we didn't need their cooperation yet, until we were closer to being up and running. I invited them all to become nodes on this ARPA Net. They all had their individual computer systems, and I was proposing to interconnect them. Many of them, I would say probably a majority of them were skeptical, to be polite. They said, we don't want somebody else coming in using our machine cycles. We don't have enough machine cycles as it is and now you're proposing to make it possible for us to give up even more of it. Doug, almost standing alone, said this is a great idea, SRI and my group will be the network information center, which will handle all the information about the ARPA Net, so that people who want to find out about getting on the ARPA Net, or finding out the location of information on the Net they can come to us. He was true to form, an early supporter, and consequently SRI was one of the first four nodes, as you heard before the break.

John Markoff: Your ARPA, ARPA of the 1960s, do you think that there are lessons in the way that you did research, or the way you funded research that we could take from you? Is there something that's been lost, that maybe now we're at this branch point, we have a chance to rethink the way the nation does research?

Bob Taylor: That's an interesting idea. ARPA was created by the Department of Defense at the instigation of Eisenhower when the nation was caught unawares of Sputnik in 1957. The idea was that the Defense Department would launch an agency that would support high risk research, with no red tape, and would have a lot of leverage in deciding what it would support without committees evaluating this proposal, or that proposal. Just go and do it. That spirit was still there when I was in ARPA. That spirit has gradually decayed over the years, I'm told. I haven't received an ARPA support since I left ARPA, but I have a lot of friends who have, and they tell me, and continue to tell me that it's just not the same thing. Now, if you want good research to be done you better give your researchers a lot of room, a lot of possibility of taking initiative, and not try to hamstring them by giving them milestones, or targets of various kinds, or too many progress reports, or one restriction, after another, after another.

Bob Taylor: Good researchers won't do good research under those conditions. I guess that's ... To answer your question, that's, as briefly as I can without getting on a big soapbox, that's my response.

John Markoff: That's perfect. Unfortunately, we're out of time. There are ten more stories I'd like Bob to tell us, but not today.

Bob Taylor: I have one more.

John Markoff: Okay. One last story.

Bob Taylor: When I was at ARPA, a couple of my bosses over the time I was there were physicists and they were wonderful, really bright, creative, imaginative people. Bob Sprow's father, incidentally was one of them, oddly enough. For example, when they would go to Congress to testify for the ARPA budget, unlike later ARPA directors, when they were asked by Congress, well what is this piece of research and computing technology have to do with the Defense Department? It doesn't have anything to do with the mission of the Army, or the Navy, or the Air Force. They would respond, this kind of research that ARPA's supporting in its basic research programs is not just for the Defense Department, it's for the nation. If we're successful the whole nation will profit from it and that shut them up. It's the right answer. Now, later at Xerox Park I had another couple of physicists who were my bosses, they were not so good. They reminded me of one of my favorite stories ... As a result, I've built a lot of stories about physicists. They reminded me of one of my favorite stories, which I'll end this session on.

Bob Taylor: The time that this takes place is in the French Revolution. The other team is set up in a huge square, and there are thousands of people surrounding a guillotine to watch the events. A priest is led up to the guillotine, he says I want to be put into this guillotine face up, so I can watch my maker as the blade falls. So they put him in face up. The executioner pulls the trigger and the blade comes crashing down, and it stops inches before it gets to the mans neck. The crowd is stunned, and then it goes wild, and says, you must set him free. God means for him to be set, he must be innocent, so they set him free. The next fellow to come up to the guillotine was a physicist, he probably supported royalty to an excess, I don't know. They put him in face up. He's lying there looking up at the guillotine, and just before the executioner pulls the trigger the physicist says, oh, I see your problem.