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Entrepreneurial Capitalism and Innovation:
A History of Computer Communications 1968-1988
By James Pelkey

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Arpanet: 1969-1972
The Beginnings of Computer Networks

4.10   ALOHANET and Norm Abramson: 1966 - 1972

The ARPANET was not the only innovative communication network undertaken by IPTO in the late 1960's. The coming into being of ALOHANET began in 1966 when Norm Abramson joined the faculty of the engineering department of the University of Hawaii. He thought he was taking a "big gamble," for although he would be able to continue his engineering research, he was giving up the intellectual stimulation of Harvard and Stanford where he had spent the last seven years. In addition, he had the challenge of finding his own funding. Then fate smiled on Abramson as he found funding that would lead to his making a permanent contribution to the development of network technologies with his radio packet switched network: ALOHANET.

Learning of a newly created ARPA program named THEMIS -- whose mission was to support research at "second tier" universities -- Abramson and two of his fellow professors, Wes Peterson and Ned Weldon, joined forces to create a team with both communications and computer background. Abramson recalls:

> "So we cast about for a research topic that we thought would make sense to the Department of Defense, that we would be interested in, and said: 'Well, communications for computers makes sense.' The telephone system appeared not to make sense at that time, especially in Hawaii, and we thought we had something that was intellectually stimulating and a package that we could sell to ARPA. That's how it all started."

In 1967, Abramson arranged through a mutual friend a meeting with Bob Taylor, Director of IPTO. Only when asked precisely what they wanted to do, Abramson could do little more than shrug. In another meeting in 1969, Abramson remembers telling Taylor and Roberts that the constraint of one communication channel per user in radio communications seemed unduly limiting. When again pressed for an alternative, Abramson could only express the frustration:

> "Something much more sensible for radio can be done here than assigning a single channel for every user in the network. That's crazy. That won't work!"

Where one person's ideas began and ended is now a blur. What is clear is that at a meeting held later in 1969, without the participation of Talyor or Roberts, the important decision to directly transmit user information in a single high speed packet burst, now known as an ALOHA channel, was made. That is, every terminal would transmit its data to the host using the same radio channel. If collisions occurred, a terminal would not receive an acknowledgment and would re-transmit. No terminal had its own dedicated broadcast channel: all terminals would use the same channel.

From a paper written in 1985 by Norman Abramson:

> "From the beginning it was clear that the nature of the radio channel provided new system design options not available in systems using conventional point-to-point telephone channels. As the network planning proceeded, this key point assumed greater and greater significance. It would be gratifying to be able to report that this key difference between radio channels, with broadcasting or multiple access capabilities, and conventional point-to-point wire (or microwave) channels was appreciated as we began the project. Unfortunately, such an appreciation developed among the members of the project only with time; as is the case in many real-world situations, our foresight was not as clear as our hindsight.

> Even at the beginning of the project, however, it was understood that the intermittent operation typical of interactive computer terminals was a convincing argument against the assignment of point-to-point channels in a conventional frequency-division multiple access (FDMA) or time-division multiple access (TDMA) manner. Some form of sharing of a common communication channel resource appeared necessary." [9]

Once again the intermittent operation of interactive computer terminals was causing communication system architects to rethink how to construct a data communications network. But what a preposterous notion - that all terminals share the same channel simultaneously!

Next came the construction of a demonstration network to prove feasibility. Two graduate students under the supervision of Abramson, Charlie Bass and John Davidson, both of whom will become important to the history of computer communications, gained important experience working on ALOHANET. Maybe the most unlikely source of help, considering the demands on his time, was Roberts

himself. Abramson writes:

> "In addition to this financial support of the ALOHANET, Roberts also contributed to the success of the project in a way not ordinarily obtained from funding agencies. In a real sense, Roberts acted as another member of the research staff of the project, contributing a number of major technical results (including the first derivation of the capacity of the slotted ALOHA channel and the first analysis of the capture effect in ALOHA channels)."[10]

ALOHANET consisted of a number of remote terminal sites all connected by radio channels to a host computer at the University of Hawaii. It was a centralized, star topology with no channels having multiple hops. All users transmitted on one frequency and received on another frequency that precluded users from ever communicating with each other -- users expected to receive transmissions on a different frequency than the one other users transmitted on. At its peak, ALOHANET supported forty users at several locations on the islands of Oahu and Maui. User terminals connected to the host computer via a terminal control unit (TCU) that communicated at 9600 bits per second. Following the installation of the first TCU in 1971, Abramson hosted a party celebrating their success. (In 1972, Abramson's focus shifted to applying the concepts developed in ALOHANET to satellite channel communications. On December 17, 1972, an IMP connecting the ALOHA host to the ARPANET by satellite channel was installed.)

The ALOHANET was never commercialized for to do so required dealing with the Federal Communication Commission (FCC), the government agency that regulated the use of radio frequencies. Writes Abramson:

> "As a research project, it was quite interesting, but to look further to operational or commercial systems was not something I would have given thought." [11]

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[9]Development of the ALOHANET, IEEE, Abramson, p119, 1985

[10] Development of the ALOHANET, Abramson, p121, 1985

[11] Ibid.

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