

DECLARATION OF DR. STEPHEN HEPPE IN SUPPORT OF *INTER*
***PARTES* REVIEW OF U.S. PATENT 6,914,893**

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I. INTRODUCTION AND QUALIFICATIONS

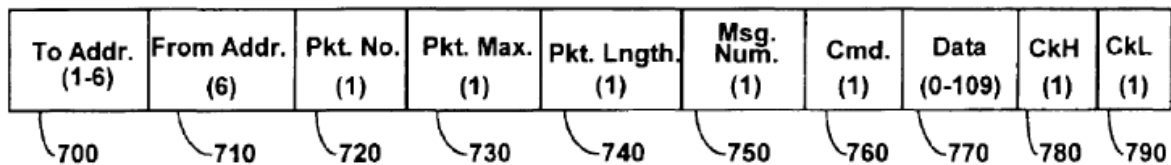
1. I am over 18 years of age. I have personal knowledge of the facts stated in this Declaration and could testify competently to them if asked to do so.

2. I obtained a Bachelor's of Science degree in electrical engineering and computer science at Princeton University in 1977, a Master's of Science degree in electrical engineering (specializing in communications) from The George Washington University (GWU) in 1982, and a Doctor of Science in electrical engineering (specializing in communications, with minors in operations research and electrophysics) in 1989. I have worked in the fields of radio communication, computer and network communications, packet radio, and ad hoc packet radio networking since 1977. In the late 1980's, I was the lead communications engineer on a project demonstrating differentially-corrected GPS-based precision approach for a military aircraft. This system relied on the AX.25 packet radio specification for air/ground communications. From 1995 through 2002, I worked on standards as well as hardware and software for an ad hoc (distributed) airborne packet radio system that could exchange GPS position reports and data between aircraft and ground stations. This included augmentations that provided routing and transmission of user data through the airborne stations, allowing transfer of data between aircraft and distant ground stations connected to the Internet or other wide area networks. My detailed CV is provided as Exhibit 1006 to the Petition.

3. I have been asked by the Petitioner, Emerson, to provide my opinions about the technical issues addressed below. I am being compensated for my time spent on this matter at my standard hourly compensation rate. I have no financial interest in the outcome of this or any related proceeding. My compensation is not dependent upon the opinions that I am providing in this declaration.

4. I have reviewed U.S. Patent 6,914,893 (“the ‘893 patent”), its file history, the prior art citations noted in my analysis and opinions, and the Claim Construction Opinion and Order issued in SIPCO v. ABB, et. al., CA No. 6:11-CV-0048 LED-JDL, on 7/30/2012. The ‘893 patent, awarded to Petite and claiming priority, through a continuation and a string of continuations-in-part, to an application filed on June 22, 1998, is directed to a computerized system for monitoring and controlling remote devices by transmitting data between remote systems and a gateway interface via a packet message protocol system (Abstract). The system comprises one or more sensors and actuators associated with “integrated” transceivers, as well as stand-alone repeaters (transceivers) and the gateway connected to a wide area network such as the Internet. The ‘893 patent teaches a packet protocol comprising a source and destination address, a message number, a command code, a data field, and an error detector. The destination address field and data field are “scalable”. The overall packet structure is illustrated in FIG. 7 of the ‘893 patent, reproduced below.

FIG. 7 Message Structure



II. PERSON OF ORDINARY SKILL IN THE ART (POSITA)

5. The subject matter of the '893 patent relates to radio communication, computer communication over local and wide-area networks, protocols for packet data communication and routing, and error control. In my experience, these subjects are normally taught at the graduate level in electrical engineering degree programs, and would consume roughly one year of focused study. It is also certainly possible for diligent engineers to learn these subjects "on the job", although the competing demands of a typical work environment would generally slow the pace of learning in these specific fields (while possibly offering a more diverse learning experience in a wider variety of specialties). Accordingly, it is my opinion that a person of ordinary skill in the art in the field of the '893 patent has, through formal education or practical experience, the equivalent of a Bachelor's Degree in Electrical Engineering and 2-3 years of experience in using, making, or selling radio communications or computer network systems.

III. CLAIM CONSTRUCTION

6. I have been informed that a claim in *inter partes* review is given the broadest reasonable construction (BRC) in light of the specification. In the subsections below, I offer my opinions on some of the terms used in the claims at issue in this *inter partes* review (IPR). The constructions set forth below are provided for the purposes of this IPR only, and may be different than constructions I would propose in litigation forums using a different standard.

A. “scalable address” (‘893; claims 1, 37)

7. The term “scalable address” has been construed as **an address that has a variable size based on the size and complexity of the system** in the 2012 Claim Construction Opinion. I believe this is appropriate as the BRC for “scalable address”. The use of a “scalable address” is described in the ‘893 patent at 12:14-27 in relation to FIG. 9, reproduced in relevant part below.

Sample Messages

Central Server to Personal Transceiver - Broadcast Message - FF (Emergency)

Byte Count = 12

To Addr. (FF)	From Addr. (12345678)	Pkt. No. (00)	Pkt. Max. (00)	Pkt. Lngth. (0C)	Cmd. (FF)	CkH (02)	CkL (9E)
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910

First Transceiver to Repeater (Transceiver) Broadcast Message - FF (Emergency)

Byte Count = 17

To Addr. (F0)	From Addr. (12345678)	Pkt. No. (00)	Pkt. Max. (00)	Pkt. Lngth. (11)	Cmd. (FF)		CkH (03)	CkL (A0)
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920

Data
(A000123456)

**Note: Additional Transceiver Re-Broadcasts do not change the message.
The messages are simply received and re-broadcast.**

8. The first sample message in FIG. 9 has a single "To" address (FF) associated with a particular integrated transceiver. The second sample message contains an additional data field (with length = 5 bytes) that is an additional address (i.e., in addition to the "To Addr. (F0)" associated with a stand-alone transceiver/repeater):

The second message 920 illustrates how the first message might be sent to a stand-alone transceiver. In this manner, emergency message "FF" from a central server with address "00123456578" is first sent to stand-alone transceiver "FO." The second message, further contains additional command data "A000123456" that may be used by the system to identify further transceivers to send the signal through on the way to the destination device. ('893; 12:20-27)

9. The stand-alone transceiver is described as a “repeater” at 8:63-66; see also 4:23-28, 4:57-63, 5:18-32, 5:49-54. Thus, it is a “repeater” or “relay” node. The “scalable address” is therefore understood to comprise at least the ability to “string together” multiple addresses to describe a multi-hop transmission path through the network of RF transceivers.

B. “scalable message” (‘893; claims 1, 37)

10. The term “scalable message” has been construed as a **“message in which the size of the message can be varied”** in the 2012 Claim Construction Opinion. This is consistent with the interpretation of “scalable address” noted above, and I believe it is appropriate as the BRC for “scalable message”.

C. “actuator” (‘893; claim 10)

11. This term appears in claim 10 in the context of “an actuator controlling a third condition and receiving control signals from the transceiver.” The “condition” that is controlled is unspecified, but should generically have the same scope as the “conditions” sensed by “sensors” (see below), although in the specific case of claim 10, the (third) condition controlled by the actuator is different from the (second) condition sensed by the sensor. The specification of the ‘893 patent provides some examples of actuators: “The addition of the actuator 320 to the integrated transceiver permits the data interface 525 to apply signals to the manual temperature control for the temperature set point, the climate control

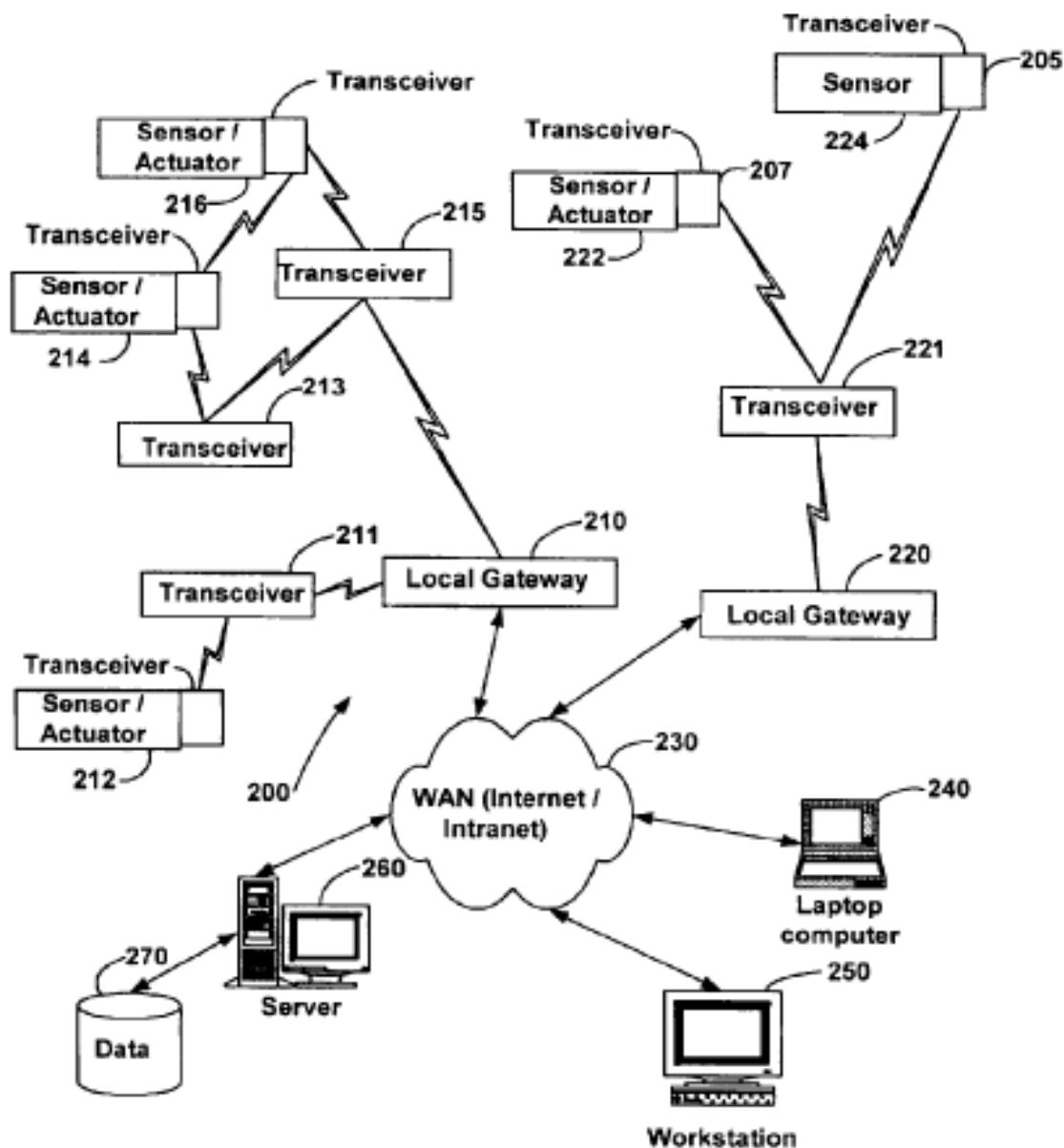


FIG. 2

mode switch, and the system on/off switch. In this way, a remote workstation 250 or a laptop 240 with WAN access (see FIG. 2) could control a home heating system from a remote location.” (‘893, 8:44-50) The abstract refers to “one or more actuators to be remotely controlled.” See also FIG. 1 and 2:1-2, where

actuators connected to a local controller (remote to a central controller) are acknowledged as prior art. While some actuators may be “binary” or “digital” (i.e., as in the home heating system example noted above), others might be “analog” (see, e.g., ‘893, 8:2-6). Given the generality of “condition” recited in claim 10, I believe the BRC for “actuator” should be **an equipment, program, or device that controls or affects the state or status of a parameter or condition.**

D. “sensor” (‘893; claims 2, 10)

12. The specification teaches a variety of analog and digital *sensors* with binary, digital, and continuous (or analog) outputs. See, e.g., 6:14-38, 6:65-7:2, 8:30-43. The scope of “sensor” does not appear to be limited by the specification, which provides a very broad context for the term: “The system comprises one or more remote *sensors to be read* and possibly one or more actuators to be remotely controlled.” (2:37-39; emphasis added). The specification provides examples of sensors including alarms (on/off), light sensors, thermometers, and sensors that can detect user inputs such as thermostat temperature settings and selected operating mode (which are sensed electrically). Thus, a sensor may measure “non-physical” parameters. The ‘893 patent envisions a system with multiple sensors. 7:57-58. Accordingly, I believe the BRC for “sensor” should be **an equipment, program, or device that monitors or measures the state or status of a parameter or condition and provides information concerning the parameter or condition.**

Parameters and conditions falling within the scope of the term should be understood to include heat, light, sound, pressure, motion, and electromagnetic and electrical parameters and conditions including user-generated inputs or data.

E. “integrated” (‘893; claim 2)

13. Claim 2 of the ‘893 patent uses “integrated transceiver” to refer to the combination of a transceiver (as claimed in claim 1) and a sensor, wherein the sensor can detect a condition and output a sensed data signal to the transceiver. The degree of *physical* integration is not specified in the claims or specification or file history of the ‘893 patent – thus, the transceiver and sensor could be e.g. on the same circuit board, or on different circuit boards or modules in the same enclosure, or in different enclosures separated by an arbitrary distance, as long as the sensor can detect a condition and output a sensed data signal to the transceiver. In reference to FIG. 3 of the ‘893 patent, the specification teaches that a transceiver may be “integrated” with a sensor (6:15-16), and in reference to the same diagram, notes that the sensor may be “communicatively coupled” with the RF transceiver (6:26-27; *see also* FIG. 3, showing a communication path passing through a data interface and a data controller). Thus, I believe the BRC of “integrated” is a **combination of elements communicatively coupled together.**

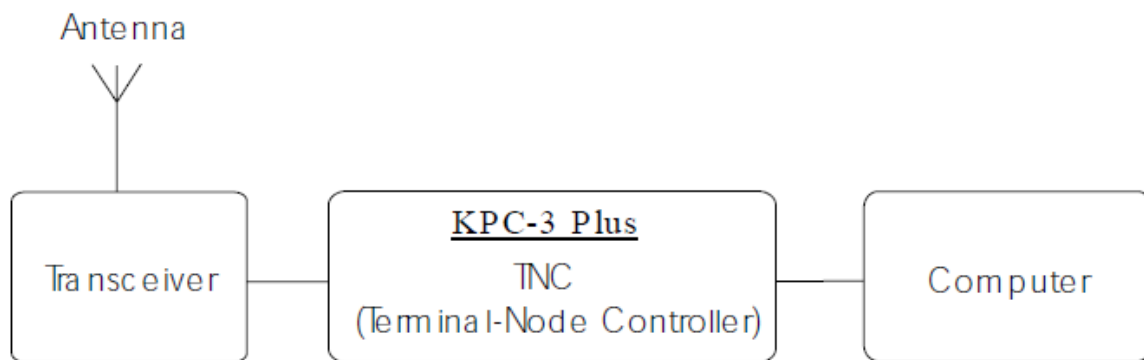
IV. SUMMARY OF PRIOR ART CONSIDERED

14. *The Kantronics Company, Inc. has been building wireless products since 1971. In 1997, they published the KPC-3 Plus User Guide [Kantronics]* for the KPC-3 Plus Terminal Node Controller (TNC) intended for amateur radio operators. Kantronics describes the KPC-3 Plus “Terminal Node Controller” (or “TNC” for short). A TNC is used in conjunction with a radio transceiver and a computer to form a packet radio station. The Kantronics reference is identified as a user guide for the KPC-3 Plus TNC. It explains how to use this TNC in conjunction with the other components to not only implement a packet radio station, but also to perform certain desirable operations with a plurality of packet radio stations (based on the KPC-3 Plus TNC, or in some cases other TNCs), such as, e.g., monitoring and controlling a remote system. In my experience, electronics typically are sold with manuals or user guides to explain to the customer how to assemble, configure and/or use the electronic equipment. Kantronics has substantial indications that it is indeed a user guide that was distributed with the Kantronics product beginning in 1997. The first indicator is the 1997 copyright date. In my experience, the copyright date in a user guide indicates when that user guide was first delivered to a customer. The content of Kantronics also indicates that it was written for the purpose of educating the purchasers of the KPC-3 Plus TNC about how to assemble, configure, and use the product. For example, page

15 of Kantronics describes the “major uses of your KPC-3 Plus” units. Page 16 tells the reader what additional equipment they will need, in order to assemble a packet radio station based on the KPC-3 Plus TNC. Page 17 tells the reader what assumptions the authors of Kantronics made about the reader of the user guide. Thus, based on my experience, the content and characteristics of the Kantronics reference lead me to believe that it is in fact a user guide distributed to Kantronics’ customers in 1997.

15. Kantronics incorporates the AX.25 standard (see “copyright page”). Kantronics provides a brief introduction to packet radio, information on installing and configuring the KPC-3 Plus packet radio station, and documentation for a PC terminal software package called Pacterm (which shipped with the hardware). Kantronics, p. 11. As noted in the User Guide, adding the KPC-3 Plus and a computer to a ham radio station allows the ham radio station to send and receive packets of digital information. This allows the operator to, among other things: send and receive mail using a community bulletin board; send and receive files; serve as a digipeater for other stations; and serve as a network node point for other stations. Kantronics, p. 15. The KPC-3 Plus hardware included two A/D inputs and two control line outputs. Kantronics, p. 14. As noted in Kantronics, a packet radio station has three basic parts: a transceiver with an antenna; a terminal node controller (TNC), which is a combination modem and special-purpose micro-

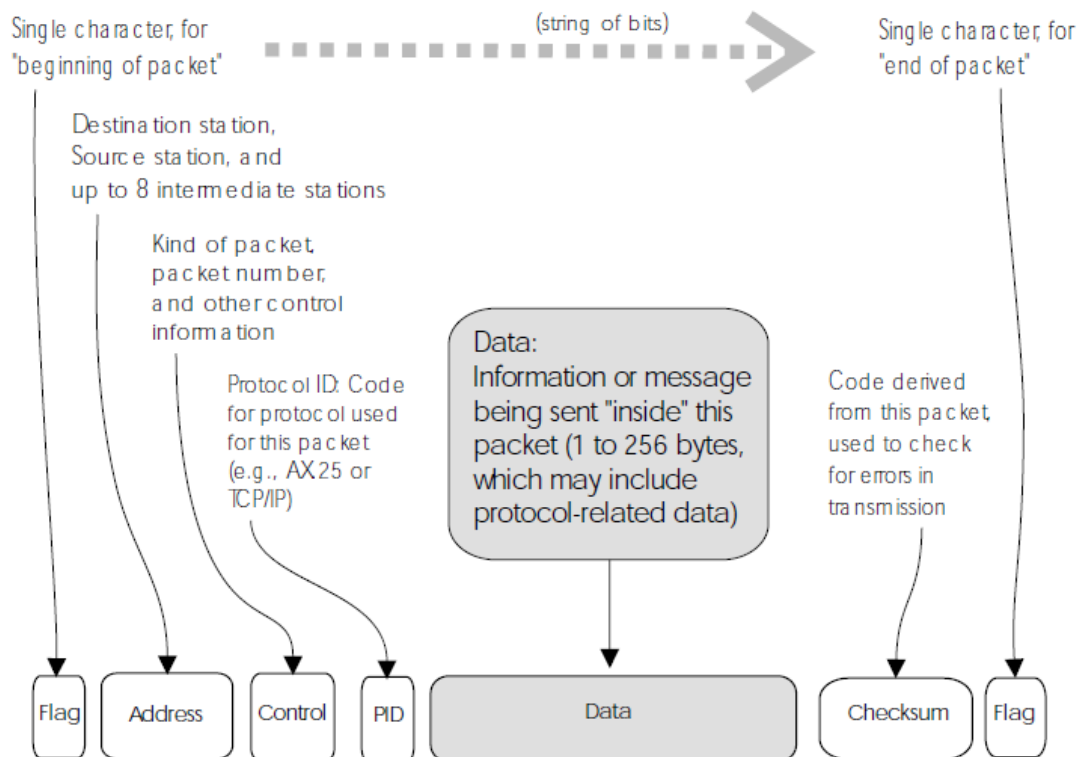
computer; and a general purpose computer (or a terminal). Kantronics, p. 18. The KPC-3 Plus is the TNC component, as illustrated by the figure at Kantronics, p. 19:



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16. Kantronics also describes the AX.25 packet structure: “All amateur radio packets (also called ‘frames’) are defined by the AX.25 protocol... The following diagram shows the basic building blocks of ‘connected information’ packets used in amateur packet radio” Kantronics, p. 26 (see diagram reproduced below).

17. Kantronics teaches that “Packet radio, like any communication, is only possible if all parties involved... agree on the rules for organizing information and the rules for dealing with all steps of the transmission. These rules are called ‘protocols,’ or standards.” Kantronics, p. 28.



18. In my opinion, since all the amateur radio packets are formatted according to the AX.25 protocol (a “convention”), they are “preformatted” within the meaning of the ‘893.

19. *Kahn, et. al., “Advances in Packet Radio Technology” [Kahn]*, is an IEEE article that indicates it was published in November 1978. I have been a member of IEEE for many years, and have read IEEE articles and publications throughout my professional career. Kahn was published as part of the “Proceedings of the IEEE,” which was and is a compendium of articles that are physically bound together and mailed to the IEEE members that subscribe to the “Proceedings.” In my experience, the publication dates listed on articles like Kahn

accurately reflect the date that the article was published to the relevant public.

Kahn provides an overview of the basic concepts of packet radio, including a then-current (1978) description of a particular packet radio network (“PRNET”), a multi-hop, multi-access packet radio network sponsored by the Advanced Research Projects Agency (“ARPA”). Kahn, pp. 1468-69. The individual nodes in the network – the packet radios (“PRs”) – comprise a radio unit and a digital unit. The radio unit comprises a transmitter and receiver (a transceiver). The digital unit comprises a micro-processor, and can be connected to a terminal or “station” that provides additional functionality as discussed further below. See, e.g., Kahn, Fig. 13 and Fig. 14. The unit of transmission in the network is a “packet” that includes a number of data bits that include “all the addressing and control information necessary to correctly route it to its destination.” Kahn, p. 1468, col. 1. See also Kahn, pp. 1478-79 and Fig. 8.

20. According to Kahn, “[a] primary objective of a packet radio network is to support real-time interactive communications between computer resources (hosts) connected to the network and user terminals (e.g., terminal-host, host-host, and terminal-terminal interactions).” Kahn, p. 1469, col. 2. This objective is fulfilled, in part, through routing by the network. Kahn, p. 1470, col. 2. Kahn describes two routing options -- point-to-point and broadcast -- and the protocols that implement them. Kahn, p. 1476, col. 1; pp. 1479-80. See Fig. 9 below.

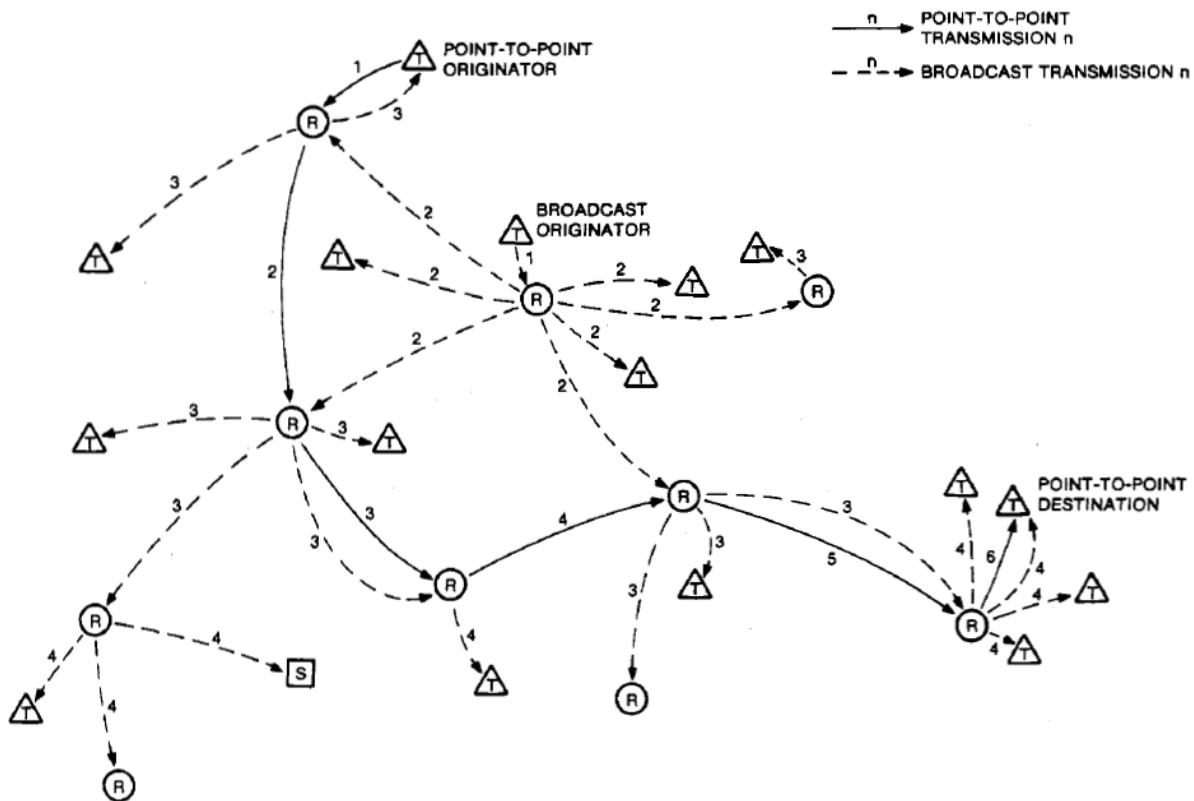


Fig. 9. Point-to-point and broadcast routing.

21. Kahn's PRNET is described as having both a centralized and a decentralized mode of operation. In the centralized mode, control protocols that have global effect are centralized in a network entity called a "station." Kahn, p. 1477, col. 1. Thus, the network has a two-level hierarchy, with nodes comprising both a packet radio and a station at the top, and nodes that comprise a packet radio, but do not comprise a station ("non-station nodes"), at the bottom. *Id.*

22. In the centralized mode of operation, a primary function of a station is to determine the topological connectivity of the network and calculate optimized routes through the network for data communication between packet radio nodes.

Each packet radio periodically transmits a “radio on packet” (ROP), and also maintains a neighbor table -- a list of neighboring packet radios with which it is in reliable direct communication (i.e., it can reliably hear the ROP packets of these neighboring nodes). Kahn, p. 1477, col. 1; Kahn, pp. 1481-82. If a PR is aware of a station exerting central control, it sends “summary ROPs” to the station at periodic intervals, conveying this connectivity information.

23. Initially, when a station is powered-up in a region containing PRs, it is not aware of any PRs. However, it will “hear” the ROP from its locally-connected packet radio (PR) on its baseband host interface. This identifies the local PR as the “root” of the network. The station “labels” its PR as a level 0 node, which informs the PR that the station is present (e.g., has been powered-up and is connected), and the PR subsequently reports its neighbor table to the station in a summary ROP. This informs the station of the neighboring PRs that are within radio range. The station can then add these PRs to its internal representation of the network, label them as “level 1” PRs, and receive their summary ROPs as well. This informs the station of even more distant PRs. The process continues until all radios in the network are labeled, and the station has assembled a topological map describing the connectivity of the network. As a consequence of this labeling process, each PR is informed of the best route from itself to the station. Kahn, p. 1477, col. 1.

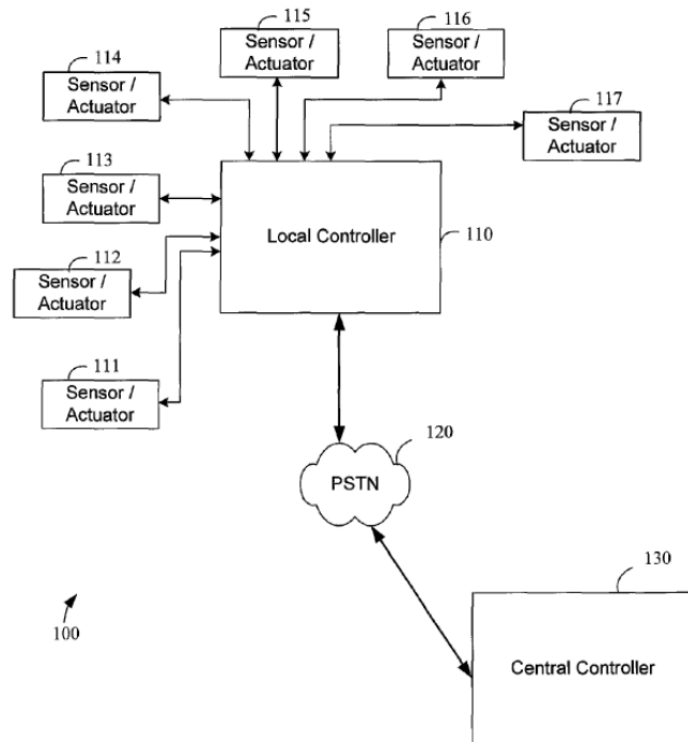
Kahn also describes methods to update the map (maintain currency), drop PRs that are no longer participating, and add new PRs that have entered the network. *Id.*

24. If a distant PR needs to send a point-to-point message to the station, comprising one or multiple packets, it can do so by transmitting the message along the route to the station which it already knows as a consequence of the labeling process.

25. If a PR needs to send a point-to-point message to a node *other than* the station, and does not know the location of the node or a best route, it sends the message to the station as well. The station will forward the message to the destination, and in parallel, compute a good point-to-point route from the source PR to the destination, and inform the source PR of this route for future transmissions to the same destination node. Kahn, p. 1480, col. 1.

26. ***Admitted Prior Art (“APA”)***. In the ‘893 patent, the applicant made several relevant admissions regarding the scope of the prior art. Applicant admitted that there were a variety of known systems for monitoring and controlling manufacturing processes, inventory systems, emergency control systems, heating, ventilation, air conditioning systems, fire reporting and damage control systems, alarm systems, and access control systems. ‘893 patent, 1:36 - 2:26. Applicant admitted that it was known to use sensors and actuators to monitor and control automated systems. See e.g., “typical approach” in the ‘893 patent, 1:55-65.

27. Figure 1 of the '893 patent, reproduced below, illustrates a prior art control system 100 comprising a plurality of sensor/actuator pairs 111-117 communicatively coupled to a local controller 110 (i.e., "integrated"). Local controller 110 formats and applies data signals from the sensors to predetermined process control functions, and returns control signals as appropriate to the system actuators. '893 patent, 2:5-8. The local controller 110 can also be integrated to a central controller 130 using the public switched telephone network ("PSTN"). '893 patent, 2:8-10.



**FIG. 1
(PRIOR ART)**

28. Thus, it was well-known (and acknowledged) that sensors and actuators could be integrated with (and controlled from) a local controller, and further integrated with a central (remote) controller over a network.

V. ANALYSIS OF CLAIMS 1, 2, 10, AND 37

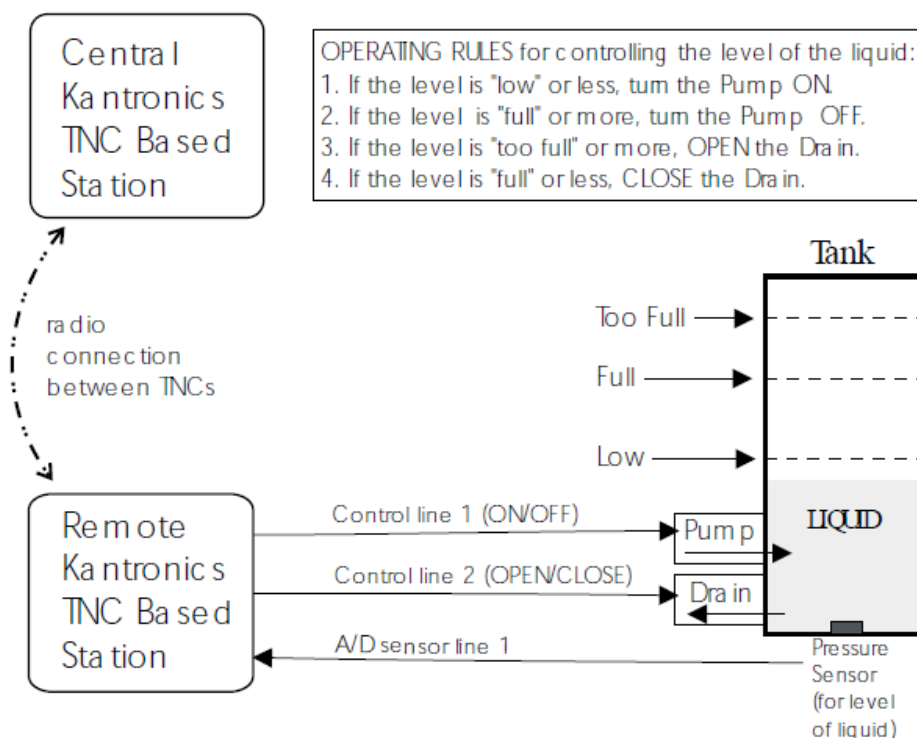
Claim 1

[1a] A system for communicating commands and sensed data between remote devices, the system comprising:

29. As noted in the background section, Kantronics discloses that a packet radio station comprises a transceiver (with antenna), the KPC-3 Plus TNC, and a computer. Kantronics, pp. 18-19. Kantronics describes a mode of operation for packet radio stations, comprising the KPC-3 Plus TNC, for “remote sensing and control” which allows an operator to “gather and report the status of one or two analog input lines in the remote TNC”, and “control the voltages on selected output lines in the remote TNC”. Kantronics, p. 166. Kantronics provides an example of how these features could be used to control the level of liquid in a tank (Kantronics, p. 167, illustrated below). Interpreted in light of the discussion on p. 166, as well as details on the ANALOG, CNTL, MYREMOTE and RTEXT commands (pp. 186-7; 199, 224-5, 238-9), this figure shows a central TNC and a remote TNC (i.e., the two stations are *remote* from each other), with *sensed pressure data* from the remote station (on A/D sensor line 1) flowing to the central station in response to an ANALOG *command* issued by the central station. It also illustrates pump and drain *commands*, to control the pump and drain, flowing from the central station to the remote station, and output on control lines 1 and 2.

Remote Sensing and Control

Example: controlling the level of liquid in a tank



30. Note: A KPC-3 Plus TNC can also transmit sensor data autonomously in a broadcast mode (i.e., without an explicit request received from a distant station) through use of the TELEMETRY command. See Kantronics, p. 245. See also, pp. 188, 250.

31. Kahn discloses that packets have associated addressing and control information ("commands", in the context of the '893 patent) in the packet:

Normal store-and-forward operation within the network takes place as follows. A user generated packet with associated addressing and ***control information*** in the packet header is input to the digital section

of his packet radio, which adds some network routing and *control information* and passes the packet to the radio section for transmission to a nearby repeater which is identified within the packet. Upon correct receipt of the packet, the nearby repeater processes the header to determine if it should relay the packet, deliver it to an attached device, or discard it. Several nearby repeaters may actually hear the packet, but only one repeater (which we call the next downstream repeater) will typically be identified to relay it. The other repeaters, will discard the packet. The packet will then be relayed from repeater to repeater through the backbone (in a store-and-forward fashion using the procedure described above) until it arrives at the final repeater which broadcasts it directly to the user's packet radio.”

[Kahn, p. 1477, col. 2; emphasis added]

32. Thus, the transmitted packets comprise “commands” which control various aspects of the packet radios which receive them (including, e.g., retransmission of certain packets with the PR serving as an “actuator” of an RF signal). Kahn also discloses “parameter change packets” (Kahn, p. 1481, col. 1) which are used by a station to command changes in the stored operating parameters of a radio within the network, such as the retransmission interval or the maximum number of

allowed retransmissions. These parameter change packets also represent “commands” within the context of the ‘893 patent.

33. Kahn also discloses measurement facilities built into the PR which “provide for the collection and delivery of measurement data over the radio channel in real-time while an experiment is being run.” Kahn, p. 1495, col. 1. In addition, as noted earlier, each PR that has been labeled by a station transmits “summary ROPs” to the station describing the nearby PRs from which it can reliably receive data (e.g., the ROPs transmitted by those stations). Thus, the PR (which comprises a “radio unit” comprising a transceiver, among other things, as well as a microprocessor-based digital unit) comprises a “sensor” which senses a “condition” and outputs “sensed data” for transmission to the station.

34. In a system with at least three tiers or levels (level 0 as the local PR for a station; level 1 as PRs communicating with the level 0 PR, and level 2 as PRs communicating with the level 1 PRs), as disclosed in Kahn at p. 1482, col. 1., the remote level 2 PRs will send their summary ROPs (sensed data) to the station via the level 1 PRs. Thus, each PR satisfies the definition of a “sensor” and the system as a whole communicates sensed data between remote devices.

35. A relay of a message, through a PR, also demonstrates: a) the presence of a “sensor” (e.g., the microprocessor of the source PR which senses a data signal on its terminal/station interface; or the receiver of the relaying PR

which senses the RF signal; or the microprocessor of the relaying PR which senses the received digital data including the packet header and error detector); b) “sensed data” (either the data received over the terminal/station interface of the source PR, or the data content of the received message at the relaying PR); c) “commands” (e.g., the route setup packets that define the transmission path; the messages themselves which, by virtue of their addressing data, command their own retransmission by a PR; and also the messages that require a link level acknowledgement, all as described by Kahn at e.g. p. 1482); d) the communication of commands between remote devices (parameter change packets, route setup packets; packets requiring retransmission); and e) the communication of sensed data between remote devices (the relayed messages themselves).

[1b] a plurality of transceivers, each transceiver being in communication with at least one other of the plurality of transceivers, wherein each transceiver has a unique address, wherein the unique address identifies an individual transceiver, wherein each transceiver is geographically remote from the other of the plurality of transceivers, wherein each transceiver communicates with each of the other transceivers via preformatted messages;

36. The Kantronics “Remote Sensing and Control” figure above [1a] shows two TNC based stations (a plurality). Kantronics, pp. 18-19, teaches that these stations each comprise a transmitter, receiver, and processor, and this is also required by the functionality disclosed in the example. Specifically, the central station is required to comprise a receiver (to receive the data from the remote station) as well as a transmitter (to send commands) and a processor (it is a TNC-

based station, which is disclosed to comprise a micro-computer (a “processor”). See Kantronics, p. 18). Also, the remote station is required to comprise a receiver (to receive the commands) as well as a transmitter (to send the sensed data) and a processor (it is also a TNC-based station).

37. The stations are in communication with each other (thus each being in communication with at least one of the plurality). The title of the figure, and the name of the “Remote Kantronics TNC Based Station”, indicate that each station is “geographically remote” from the other – they are “located separately”. See 2012 Claim Construction Opinion, pp. 6-11. While the figure only illustrates two stations, a POSITA would understand Kantronics to teach a system where two *or more* packet radio stations (i.e., including repeaters also located separately) could be used in order to control the level of liquid in the tank. Kantronics, p. 166, disclosing two (or more) packet radio stations as well as the MYREMOTE command used to establish control of a remote Kantronics TNC-based radio station and issue commands for the remote TNC to carry out. See also Kantronics, pp. 19-24 and pp. 105-106, for a discussion on how to connect to a remote station through a string of digipeaters.

38. Kantronics discloses that all stations involved have to have station callsigns, which are used by the TNCs involved to identify and process information (e.g., source, destination, and routing of information). Kantronics, p. 20. A station

callsign is an address within the meaning of the '893 patent. The installation and configuration procedure (Kantronics, pp. 45-46) requires an amateur operator to enter his/her amateur callsign to prepare the KPC-3 TNC for use (it will not operate without this configuration parameter); see also the MYCALL command at Kantronics, p. 223. Amateur callsigns are unique worldwide. The MYCALL command automatically configures the station ID (the address or callsign associated with the station transceiver) as the amateur's callsign with a "substation ID" (SSID) of 0. It also configures the associated ID (address) for the personal bulletin board system resident in the TNC (MYPBBS) as the amateur's callsign with SSID = 1; and the associated ID (address) of the KA-Node feature of the TNC (MYNODE) as the amateur's callsign with SSID = 7. See, e.g., Kantronics, p. 224.

39. Kantronics teaches that the callsign of the station (the address of the transceiver) can be reset at the command line without affecting the addresses of MYPBBS and MYNODE. Kantronics, p. 223.¹ All packets originated by the TNC (and therefore transmitted through the associated transceiver) will contain the station's callsign (including the SSID extension) in the FROM address field.

¹ A POSITA would understand that a callsign might be changed at the command line in order to change the SSID associated with the station transceiver.

40. It is also possible to reset the IDs (addresses) associated with the internal functionality of the TNC, such as e.g. the KA-Node and PBBS. However, Kantronics makes clear that these are different from one another (i.e., they are unique). See, e.g., Kantronics pp. 223-224. Furthermore, while the assigned names can be aliases which are different from an amateur's callsign, a careful reading of Kantronics shows that these are merely aliases used for human convenience and do not change the address actually included in the transmitted messages. In the AX.25 packet radio networks supported by e.g. the KPC-3 Plus, a station can broadcast its aliases and associated functionality in a special message that allows other stations to associate these aliases with the actual station address. See HID command, Kantronics, p. 211.

41. The KPC-3 Plus (the hardware and software design) incorporates the AX.25 Level 2 Version 2 packet protocol adopted by the American Radio Relay League. See, e.g., Kantronics copyright page. AX.25 is a "convention" or "standard" that defines the format of messages exchanged by the AX.25 stations. See also Kantronics p. 27 (packet format illustration) and p. 28 ("Protocols: Rules for Working Together). The KPC-3 Plus TNC (its hardware and software) is designed and programmed to process messages conforming to the formats defined in the AX.25 standard.

42. Kahn discloses that:

“We assume that *a set of radios distributed throughout a geographic area*, which we call the backbone, provides a carrier-like packet communication network service to the users. *These backbone radios, known as repeaters, receive packets from nearby users and relay them. The repeaters also accept packets from other nearby repeaters for relaying.* This extends the range of the system beyond line of sight.” Kahn, p. 1477, col. 1; *emphasis added, disclosing communication between separately located remote transceivers. See also Fig. 12 (page 1489), illustrating a plurality of transceivers that are geographically remote (i.e., “separately located”) from each other. See also 2012 Claim Construction Opinion, pp. 6-11.*

“An individual packet radio unit is a small piece of electronic equipment which consists of a radio section and a digital section which controls the radio [26]. The radio section contains the antenna, *RF transmitter/receiver*, and all signal processing and data detection logic associated with modulation and demodulation. *The digital section contains a microprocessor controller plus semiconductor memory for packet buffering and software.*” Kahn, p. 1477, col. 2;

emphasis added, disclosing an RF transmitter/receiver (a “transceiver”) and microprocessor.

“For military operation, where a separate backbone network might be infeasible to deploy, each user's radio might be equipped to support not only his own traffic but that of other designated users. That is, the user's radio may also have to "double up" as a repeater, to support network traffic. In this case, we do not identify a separate backbone repeater network per se, since it would be indistinguishable from the network of user packet radios.” Kahn, p. 1477, col. 1.

“Consider a collection of *geographically distributed packet radios*, each of which is powered on and capable of communicating packets to some subset of radios within line of sight propagation range.”

Kahn, p. 1481, col. 2; emphasis added.

“The initial ARPA program objective was to develop a *geographically distributed network consisting of an array of packet radios managed by one or more mini-computer based “stations,”* and to experimentally evaluate the performance of the system.” Kahn, p. 1488, col. 2; emphasis added.

43. Furthermore, Kahn teaches that: “The station reroutes the packets to their destination, and in parallel, computes a good point-to-point route from *the indicated source PR* to the destination. It then deposits this route in *the source PR*, and later packets are routed directly to their destination instead of being routed through a station.” Kahn, p. 1480. A POSITA would understand that the use of the definite article (“the”) indicates that the source PR has a unique ID – if it were not unique, the calculated route could be delivered to the incorrect packet radio unit, resulting in the improper routing of packets and possible loss of packets. For this reason also, a POSITA would understand that the source PR ID is unique.

44. Finally, Kahn teaches that:

“An important potential use of such a mechanism is to use *the unique identifier of the next intended receiver* as one input, thus generating a waveform which is associated with a particular slot and a particular receiver. *While in the receive mode, each radio would use its own unique identifier* to generate the reference pattern for its receiver.”

Kahn, p. 1487; emphasis added.

45. This discloses that each radio (transceiver) has a unique identifier. While the specific wording references a “receiver” and a “radio” instead of a “transceiver”, the referenced “radio” is in fact a transceiver which has both a “receive mode” (explicitly referenced) and a “transmit mode” as implied by this

citation (the “upstream radio” is transmitting to the intended receiver, and all the packet radios discussed in Kahn have similar or identical construction), along with a processor, as discussed in Kahn, for example, at p. 1490 (an EPR may operate as a repeater, or may be connected to a user host, user terminal, or station). The radio is also required to be a transceiver in order for the radio to handle the RF network protocol and relay the received message if it is required to do so.

46. The disclosure of a unique address for each transceiver is further emphasized at the bottom of page 1479 (last paragraph in col. 1 and footnote 1), where Kahn notes that each radio has an identifier called a “selector”; and, “for the purposes of this paper, we assume the selectors are unique and preassigned...” This discloses an embodiment, conceived by the authors, where each transceiver has a unique address, even if it is a “simplifying restriction” adopted for clarity.

47. Kahn also discloses the format of the messages communicated by the packet radios: “... we refer to the operation of an experimental packet radio, in which a transmitted packet has the structure shown in Fig. 8. It consists of a 48 bit preamble followed by a variable length header (typically 96-144 bits), followed by the text and a 32 bit checksum.” Kahn, p. 1478.

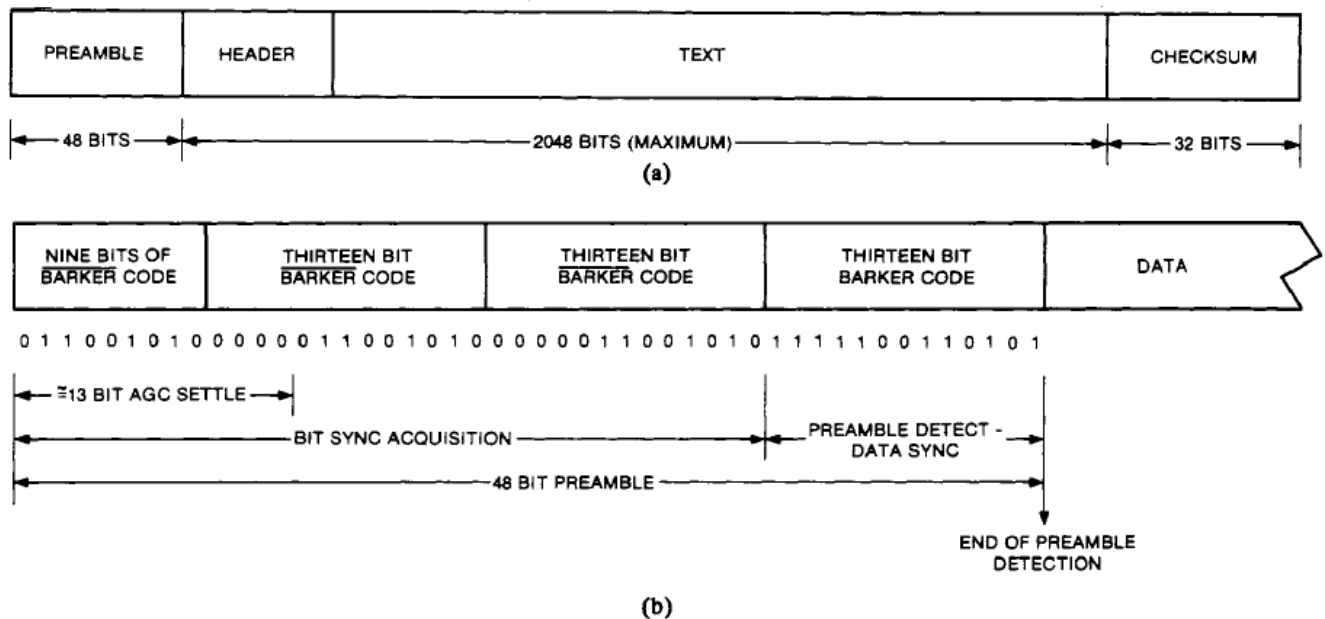


Fig. 8. Structure of a transmitted packet. (a) EPR packet format. (b) EPR packet preamble detail.

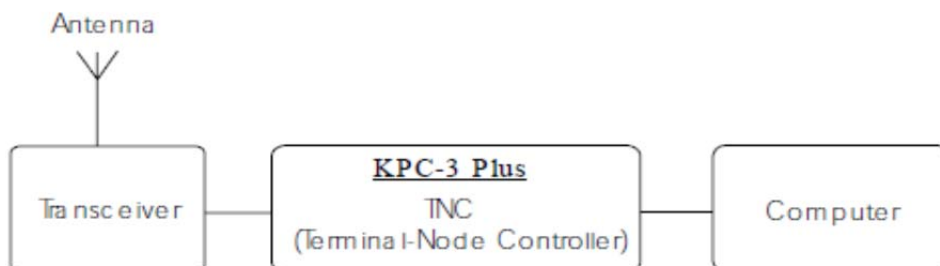
48. Furthermore, “Both the header and text are delivered from the radio section to the digital section which knows the header format and can therefore determine the exact start of the text. The error control bits consist of a checksum appended by the transmitter and checked by each receiver.” Kahn, p. 1479. In combination with Fig. 8 above, this teaches that the packets are “preformatted” (the receiver knows the format of the header ahead of time).

[1c] a controller, connected to one of the plurality of transceivers, the controller being in communications with each of the plurality of transceivers via a controller transceiver, the controller communicating via preformatted messages;

49. Kantronics indicates that each TNC (and the computer to which it is attached) has a transceiver with which it is associated (as shown below) and

communicates with different transceivers in the system via its transceiver.

Kantronics, pp. 19-24.



50. In the “Remote Sensing and Control” example of Kantronics (Kantronics, pp. 166-167), the central station comprises a controller connected to a TNC-based packet radio station comprising a transmitter, receiver, and TNC with its own special-purpose micro-computer. See, e.g., Kantronics, pp. 18-19. The two computers of the central station (the special-purpose micro-computer of the KPC-3 Plus TNC (Kantronics, p. 18) and the computer to which it is attached (Kantronics, p. 19)) control the operation of the local packet radio station, as well as some of the functions of the remote station (e.g., the pump and drain functions as well as the remote station’s transmitter which is operated in order to send acknowledgments and sensed data in response to commands from the central station).

51. The remote sensing and control illustration on page 167 of Kantronics depicts two transceivers; however, the textual description references “two (*or*

more) packet radio stations”. Kantronics, p. 166, emphasis added, indicating the potential to employ repeaters. Thus, the central station depicted in this illustration can communicate with multiple other transceivers. Each of the modules in Kantronics that qualifies as a controller also communicates via preformatted messages (i.e., the AX.25 standard, and the additional protocols supported by the KPC-3 Plus).

52. Kahn discloses that:

“An individual packet radio unit is a small piece of electronic equipment which consists of a radio section and a digital section which controls the radio [26]. The radio section contains the antenna, RF transmitter/receiver, and all signal processing and data detection logic associated with modulation and demodulation. *The digital section contains a microprocessor controller* plus semiconductor memory for packet buffering and software.” Kahn, p. 1477; emphasis added.

53. Thus, Kahn discloses a microprocessor “controller” (part of the digital section of a packet radio unit) which is connected to the packet radio unit’s RF transmitter/receiver. In a stationless mode of operation (Kahn, pp. 1484-1485), “each radio initially relies on broadcast routing to all radios in the net in order to communicate with any destination.” This discloses a controller in communication

with each of the plurality of transceivers via a controller transceiver. As noted earlier, communication is via preformatted messages. For example, the route finding packet, route setup packet, and normal data traffic packets (Kahn, p. 1484) are all “preformatted” so that receiving stations can interpret and operate on them.

54. Kahn also teaches that the entire network can be controlled and managed by a “station” which controls the operation of other devices:

“... all network control protocols which can have global effect are specifically initiated by one or more entities in the network called *stations*.” Kahn, p. 1477.

“The functions of a station are associated with global management of the radio net [24]. Generally speaking, each station is aware of all operational radios in the network. The stations discover the existence of new radios waiting to enter the net and determine when other radios have departed. ***The station determines the route to each of these radios and plays an active role in initializing, organizing, and maintaining the operational network.***” Kahn, p. 1477. See also Fig. 9 below (the station is indicated by the square with the “S” at lower left).

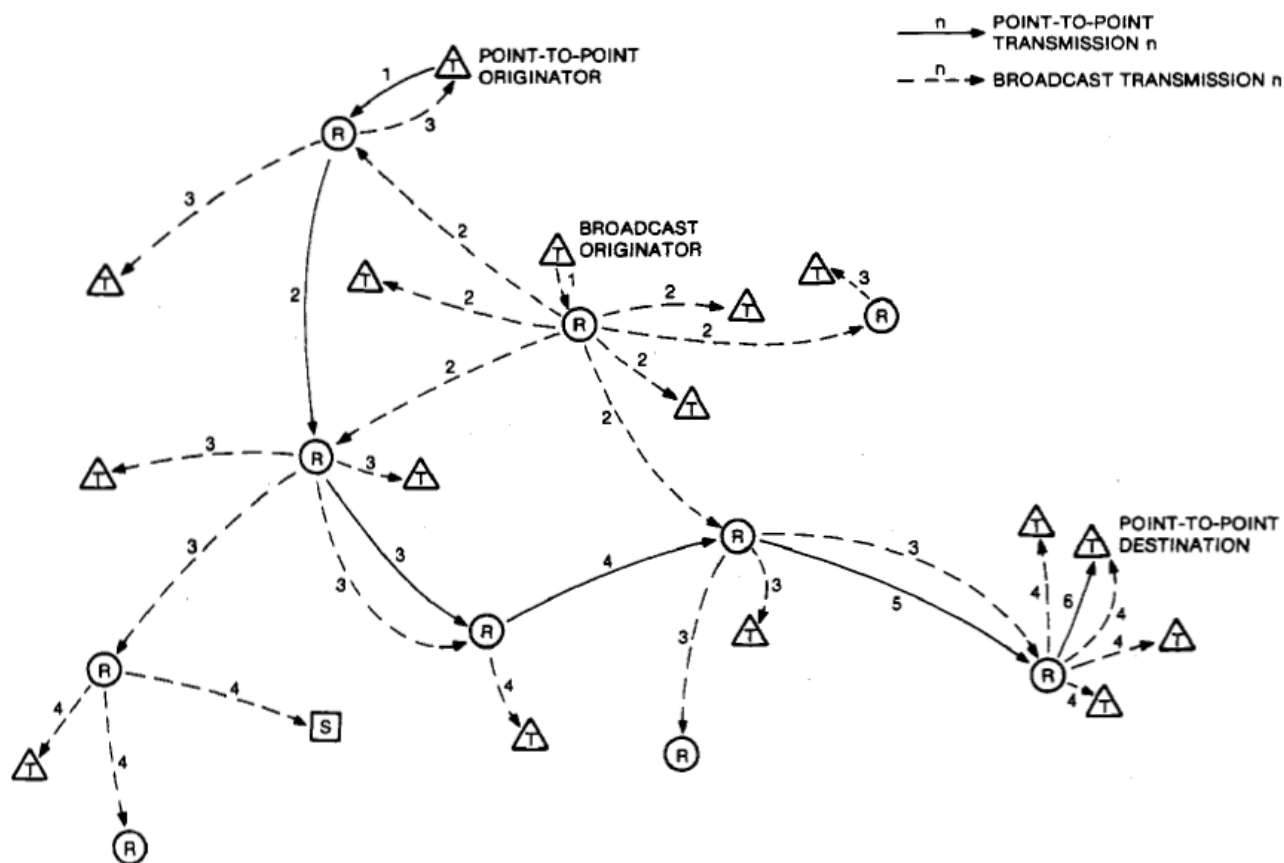


Fig. 9. Point-to-point and broadcast routing.

55. A POSITA would understand that the “station” is a “controller” within the context of the ‘893 Patent since it controls the operation of other devices. For example, Kahn teaches that the station software (installed in 1977) included *inter alia*: network routing control; a debugging facility which supported examining and depositing the contents of memory in the PR units (i.e., controlling the PR units to turn traffic sources on and off, collect and send information, and store information and operating parameters sent to them); and an experiment configuration control module. Kahn, p. 1481; p. 1485; p. 1488; p. 1494; p. 1495.

Furthermore, the station is in two-way communication (either directly, or through repeaters) with every packet radio unit in the network it controls (each such packet radio comprising a transceiver) through its own local (“controller”) transceiver. This is emphasized by the following teachings:

“A primary source of link information is the PR neighbor table whose *entries are collected by each radio, summarized, and regularly sent to the station* along with other status information.” Kahn, p. 1477; emphasis added, disclosing that each radio in the network can send measurements *to* the station (the station has a receiver).

“The station then deduces the overall connectivity of the network (we assume topologically rather than topographically) and determines good routes to itself from each of the radios in its subset. *The station then distributes to each radio in its subset the route from that radio to the station.*” Kahn, p. 1477; emphasis added, disclosing that the station can send network routing information *to* each radio in its subset (it has a transmitter).

56. As noted earlier, Kahn discloses that measurement facilities built into the packet radio and station software “provide for the collection and delivery of measurement data *over the radio channel* in real-time while an experiment is

being run.” Kahn, p. 1495; emphasis added, disclosing that the information is sent and received using the RF transceivers associated with the PRs and the station.

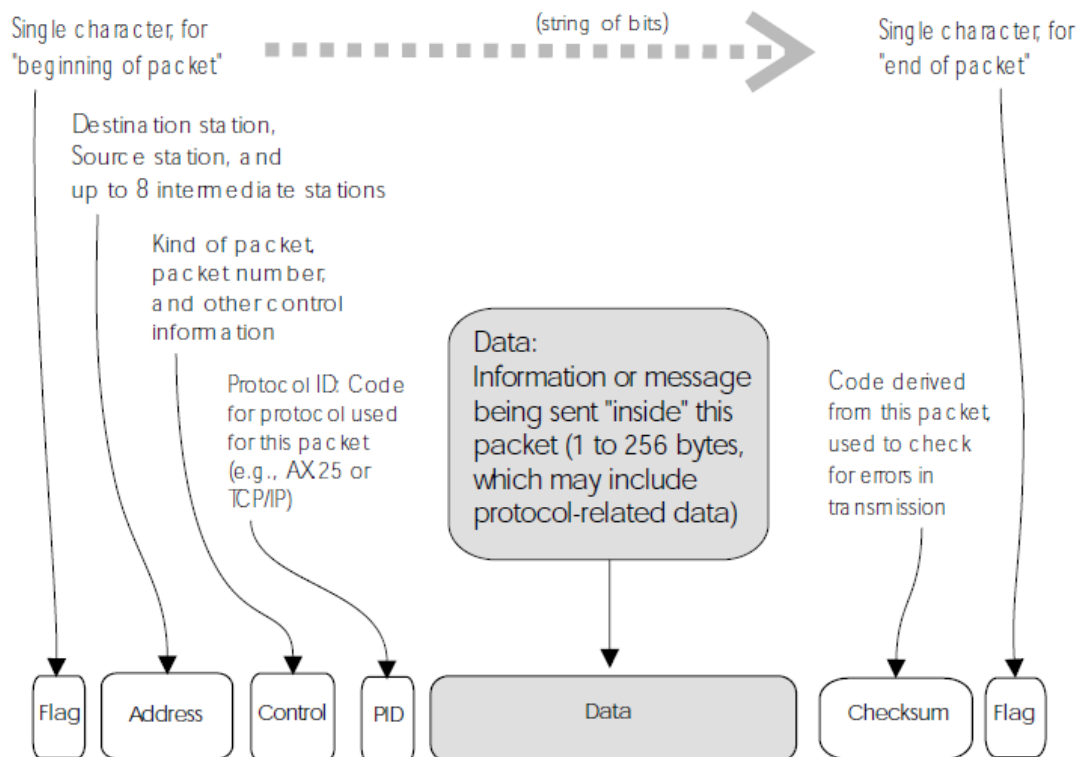
Fig. 12 of Kahn (p. 1489) also illustrates wireless (radio) communication, over distances in excess of 50 km, between the fixed and mobile packet radio units of the packet radio testbed during 1977. The “station” is illustrated as a small square in the vicinity of Menlo Park.

57. In a stationless mode of operation, the microprocessor controller contained in the digital section of the packet radio performs the functions of route discovery (involving broadcast routing of a “route finding packet” to all radios in the network), route setup, and control of normal data traffic. Kahn, p. 1484. When a station is present, the microprocessor controller first routes packets to unknown users via the station, but then receives an optimized route from the station and subsequently controls the point-to-point routing of a packet to a destination packet radio unit based on that information. Kahn, p. 1479. See also, Kahn, p. 1490.

[1d] wherein the preformatted messages comprises at least one packet, wherein the packet comprises:

58. For Kantronics, “All amateur radio packets (also called ‘frames’) are defined by the AX.25 protocol... The following diagram shows the basic building blocks of ‘connected information’ packets used in amateur packet radio”

Kantronics, p. 26 (see diagram reproduced below).



59. Kahn discloses that:

“In a packet-switched network, *the unit of transmission is called a packet*. It contains a number of data bits, and is usually of variable length up to a maximum of a few thousand bits. A packet includes all the addressing and control information necessary to correctly route it to its destination.” Kahn, p. 1468; emphasis added, disclosing “packets”. *Note: Since packets cannot be subdivided (they represent the “unit of transmission”), the messages comprise at least one packet. See also Kahn, pp. 1478-79 and Fig 8 (reproduced above) describing the details of the “preformatted” packet structure.*

[1e] a receiver address comprising a scalable address of the at least one of the intended receiving transceivers;

60. Kantronics employs the AX.25 protocol. The address field is “scalable” to include up to 8 intermediate stations. Kantronics, p. 27. In the “Remote Sensing and Control” example (Kantronics, p. 166-167), with only two packet radio stations (the smallest number indicated on page 166), there are no intermediate nodes and the receiver address field in every packet only contains a single address. A POSITA would understand that this situation can be generalized to any packet radio network where all users are within radio range of one another, so that no intermediate stations are required and the receiver address field would only need to contain a single address (i.e., that of the intended destination). But Kantronics also teaches that remote sensing and control could involve *more than* two packet radio stations, therefore involving intermediate nodes and an extended receiver address field with up to 8 additional addresses (of relay nodes) in each packet. See also differing degrees of complexity at p. 20 (relay communication between W0XI and KB0NYK using N0GRG as a relay/digipeater station); p. 99 (two relay/digipeater stations); p. 105 (three relay/digipeater stations).

61. A POSITA would also understand that amateur radio call signs are variable in length from four characters to six (this is also clear from Kantronics, p. 152), and the address field in the AX.25 packets employed by the KPC-3 TNC (disclosed in Kantronics) can accommodate this variable length.

62. Kahn teaches several addressing and route specification techniques. In one alternative, the repeaters maintain routing tables for intended end-to-end links, and each packet contains a link-level source and/or destination identifier used to index the routing table (in addition to the end-to-end source and destination addresses which define the end-to-end routing). In a second alternative, the entire route is explicitly defined in the header of each packet. In a third alternative, the header contains some, but not all, of an end-to-end route. For example:

“In this case, each succeeding packet would only require some form of source and/or destination identifier but would not have to carry the entire route in its header. Alternatively, the station can send it directly to the digital section of the sender’s (or receiver’s) packet radio. In this case, each packet originating at that radio could then contain the entire set of selectors in its header.” *Kahn, p. 1479; disclosing link-level source/destination identifiers and description of an entire route.*

“Regardless of how the routing entries are finally created within the repeaters along the point-to-point route, it may still be desirable to carry *along* within each data packet the selector for the next downstream repeater, or even the next few repeaters.” *Kahn, p. 1479; disclosing a “next” link-level destination identifier, or several sequential identifiers.*

“A packet may *also* contain an entire path of route selectors in the text of the packet. This case may be distinguished by a special bit in the packet header which indicates that the text contains all the route selectors. Such a packet is known as a route setup packet and is used to initialize or refresh the renewal table entries in each repeater. Upon receipt of a route setup packet, a repeater extracts the renewal table information (normally a few entries) from the entire list of selectors in the text and writes it into the renewal table. The contents of a route setup packet are normally inserted by the digital unit of the destination PR. Any packet may be a route setup packet, subject only to the maximum packet length constraints of the network. A route setup packet may *also* contain data.” *Kahn, p. 1482; disclosing a portion of the technique used to determine a route, and distribute the routing information to the repeaters along the route.*

63. Since this route setup packet can contain an arbitrary number of addresses defining the “intended receiving transceivers” along the route, as well as other data, a POSITA would consider the route setup packet to contain a scalable address.

64. Considering these disclosures, a POSITA would understand Kahn to teach that the “receiver address” contained in a packet is not limited to the final

destination address, but could also comprise some or all of the intended repeater addresses along a selected route (i.e., depending on the network protocols adopted by a network designer, and the complexity of the system). In a system where all radio stations are within mutual line-of-sight of all other radio stations, a POSITA would understand that intermediate repeaters may not be required (since every destination is accessible on a single hop from every source). In this case, no field for a repeater address would be needed. Alternatively, in a radio network of greater complexity or geographic extent, intermediate relay or repeater nodes may be required. Kahn teaches several methods for controlling the route of a packet, in such a system, including methods that involve varying numbers of receiver addresses in a route setup packet, or a more typical packet once the route is setup.

[1f] sender address comprising the unique address of the sending transceiver;

65. Kantronics discloses the use of AX.25, where the unique address of the sending transceiver is the amateur's call sign (which is unique worldwide), plus an SSID. Use of the MYCALL command, without an explicit SSID, forces the SSID to a default value of 0. "All packets originated by the TNC will contain this callsign in the FROM address field." Kantronics, p. 223. Thus, in a system where all users employ the KPC-3 Plus TNC, and all users adopt the default addressing built into the KPC-3 Plus software, each user's transceiver would be associated

with a unique address that is the user's unique amateur callsign plus an SSID of 0. These transceiver addresses would all be globally unique.

66. While the user is free to choose an SSID different from 0 (any number between 0 and 15 inclusive), the combination of the callsign and SSID must be different from the addresses used for the extended functionality of the TNC, such as MYALIAS, MYNODE, MYPBBS, MYREMOTE. See, e.g., Kantronics, pp. 223-224.

67. For Kahn, the use of the definite article at p. 1480 ("The station reroutes the packets to their destination, and in parallel, computes a good point-to-point route from *the indicated source PR* to the destination. It then deposits this route in *the source PR*, and later packets are routed directly to their destination instead of being routed through a station"; emphasis added) demonstrates that the source packet radio (comprising the claimed "sending transceiver") has a unique address. This unique address is the "sender address" of the packet which was sent to the station, and which generated the station's response containing the computed point-to-point route from the indicated source PR to the destination.

68. Kahn also discloses an embodiment, conceived at least for clarity of exposition, where the "selectors" are unique and preassigned. Kahn, footnote on p. 1479. This further emphasizes that the sender address comprises a unique address of the sending transceiver.

[1g] a command indicator comprising a command code;

69. Kantronics, in the “Remote Sensing and Control” example, discloses control of a pump and drain using the CNTL command (Kantronics, pp. 166-167, p. 199). After establishing an authorized connection for control of a remote TNC using the MYREMOTE command and protocol, CNTL allows a user to transmit a command to set an output voltage on one of two output lines (or both) either high or low (+5 volts or 0 volts), or “pulse” the output.

70. Furthermore, Kantronics discloses both an “unconnected” mode of operation (also called “CQ” or “UNPROTO”), as well as a “connected” mode. Kantronics, pp. 102-104. In the connected mode, a connection is first established and then data is sent and acknowledged. “If an acknowledgment is not received, the TNC will resend the data (depending on the setting of AX25L2V2, it may send a poll first).” Kantronics, p. 102. A POSITA would understand that the “poll” is a command to the destination station to force an acknowledgement indicating the sequence number of the last packet received.

71. Furthermore, Kantronics discloses a method for “digipeating” packets through up to 8 intermediate relays. See Kantronics, pp. 105-106. A user can setup a path by typing a command string to the TNC such as “C KB0NYK V IAH, LAG, AUS” which can be interpreted as “Connect to station KB0NYK through (via) the intermediate relays with aliases IAH, LAG and AUS”. Kantronics, p.

105. Packets are retransmitted by the intermediate relay nodes, in the correct sequence, in order to deliver information from the source to the destination, and back again. A POSITA would understand that this is achieved, in part, by placing the station IDs of the relay nodes in the extended destination address field of an AX.25 packet. A receiving station parses the destination address field looking for its own station ID. If it is required to retransmit the packet (this determination is based on finding its own station ID in the list, and verifying that any previously-listed stations have already retransmitted the packet), it will retransmit. Thus, the presence of a station ID in the extended destination address field is indicative of a command. In a simple scenario, there is a single digipeater between two stations which is used for all end-to-end communications. In this scenario, each packet contains the relay station ID in the extended destination address field, and this is interpreted by the digipeater as a command to retransmit the packet.

72. Kahn discloses that: “In a packet-switched network, the unit of transmission is called a packet. It contains a number of data bits, and is usually of variable length up to a maximum of a few thousand bits. *A packet includes all the addressing and control information necessary to correctly route it to its destination.*” Kahn, p. 1468; emphasis added. “Normal store-and-forward operation within the network takes place as follows. A user generated packet with associated addressing *and control information in the packet header* is input to the

digital section of his packet radio, which adds some network routing and control information and passes the packet to the radio section for transmission to a nearby repeater which is identified within the packet.” Kahn, p. 1477, emphasis added. The general control information, as well as the “control information” used specifically for routing, is a command indicator comprising a command code.

73. A specific example of a packet containing control information used for routing is the “route setup packet” which contains all the information needed to setup a route through a sequence of intermediate repeater nodes. As disclosed by Kahn at p. 1482, a route setup packet is distinguished by a special bit in the packet header which indicates that the text contains all the route selectors. This is a command indicator comprising a command code (i.e., directing the receiving stations to treat the packet as a route setup packet). Upon receiving a route setup packet (i.e., this bit is set), a repeater extracts the renewal table information (normally a few entries) from the entire list of selectors in the text and writes it into the renewal table. Kahn, p. 1482.

74. Subsequently, a packet requiring retransmission by the repeater node is structured to contain information which the repeater node will interpret as a command to retransmit the packet (assuming it was received without error).

75. Kahn also teaches the remote debugging of nodes throughout the system. Kahn, pp. 1488-94. Specifically, “By using internet protocols to access

the station's X-RAY process, even the radios can be remotely debugged from the ARPANET" (p. 1494, col. 2). A POSITA would understand that this involves command messages, sent from the station to a remote radio, to collect and report data, install new software, set operating parameters in each PR and terminal device in the network, and turn traffic sources on and off. Kahn, pp. 1494-1495.

[1h] at least one data value comprising a scalable message; and

76. Kantronics discloses a variable-length ("scalable") data field of 1 to 256 bytes. Kantronics, p. 27. See also PACLEN command, Kantronics, p. 227. This is a data value comprising a scalable message. In operation (while conversing with a distant station), two things determine when a packet is sent. Typically, hitting the carriage return or ENTER key will force the TNC to make a new packet with the recently-typed text (the key that forces a packet transmission can be set with the SENDPAC command). Also, if the user does not "force" a packet transmission in this way, eventually the amount of buffered text will match the PACLEN parameter. This can be set to any value from 1 to 256 bytes (Kantronics, p. 227), and at that point, the TNC will make a new packet even though the ENTER key (or equivalent) was not pressed. See, e.g., Kantronics, p. 104.

77. In reference to Fig. 8 of Kahn which was reproduced above, Kahn teaches: "For the following discussion, we refer to the operation of an experimental packet radio, in which a transmitted packet has the structure shown in Fig. 8. It

consists of a 48 bit preamble followed by a variable length header (typically 96-144 bits), followed by the text and a 32 bit checksum.” Kahn, p. 1478. Fig. 8 indicates that the combination of the header and the text portion of a packet can comprise up to 2048 bits (maximum). Since the header is 96-144 bits, the text portion represents a data value (“scalable message”) that can be up to 1900 bits (approximately), although it could be smaller. A POSITA would understand the use of the word “maximum” in Fig. 8 to indicate that the combination of the header and text could be less than 2048 bits, and that the text portion could be variable in length down to (potentially) zero length. This understanding is reinforced by the additional teaching of Kahn, p. 1470, col. 1, that “The capacity of the packet radio system should allow for *variable length packet sizes up to* a few thousand information bits...” (emphasis added).

78. Furthermore, Kahn teaches that “Any packet may be a route setup packet, subject only to the maximum packet length constraints of the network. A route setup packet *may also* contain data.” Kahn, p. 1482, col. 2, emphasis added. The route setup packet contains the route in the text portion of the message. *Ibid.* If the set of selectors defining the route is treated as the claimed “data value”, it is clearly a “scalable message” whose length depends on the number of repeaters identified. In the alternative, the statement that “the route setup packet may also contain data” indicates that the non-routing data (the additional text portion) is

variable length, since its maximum length would be reduced by the length of the data defining the transmission path; and also, that the additional (non-routing) data might have zero length.

[1i] an error detector comprising a redundancy check error detector; and

79. Kantronics discloses a checksum for error detection, “based on the combination of characters that are in the packet. This number is recalculated by every station that receives the packet and if it does not match the number that is in the packet, the packet is thrown away, thus near error-free communications.” (Kantronics, p. 101; emphasis added. See also p. 27). Since the checksum is based on the combination of characters in the packet, it is “redundant information.” It is “checked” by every receiving station (i.e., by a process involving recalculation and comparison to the checksum in the packet).

80. A POSITA would understand that the checksum disclosed by Kantronics is a 16-bit frame check sequence (a CRC-16-CCITT “cyclic redundancy check” satisfying the plain and ordinary meaning of the claimed “redundancy check error detector”).

81. Kahn discloses that: “The radio unit completes the packet format previously illustrated in Fig. 8 by adding a 32 bit *cyclic redundancy checksum (CRC)*, then differentially encodes the data, and adds (modulo two) the appropriate PN chip pattern for the selected data rate.” Kahn, p. 1490, emphasis added.

[1j] wherein the controller sends preformatted command messages via the controller transceiver, and the plurality of transceivers send preformatted response messages.

82. As noted above, Kantronics discloses that all messages using the AX.25 protocol are “preformatted” (i.e., they conform to a convention, protocol or standard). Kantronics also teaches the use of “controllers” (i.e., any TNC is a “Terminal Node Controller” comprising a micro-computer; the radio station as a whole can comprise a separate computer). Kantronics also describes the remote control of fluid levels (thus disclosing a controller) using the ANALOG and CTRL commands (Kantronics pp. 166, 167, 184, 199), and response messages returned from the remote station in response to the ANALOG command. Kantronics also describes digipeater operation (where any station/TNC defining a path involving repeaters would also comprise a “controller” since it is controlling the transmission of a remote station). Kantronics also discloses acknowledgments in the “connected” mode, including forced acknowledgments using a “poll”. Kantronics, p. 102. The poll represents a preformatted command message, and the acknowledgments (whether explicitly commanded or not) represent preformatted response messages.

83. A user employing the KPC-3 Plus TNC can connect and disconnect to multiple stations in sequence, thereby satisfying the limitation that a plurality of transceivers send preformatted response messages. Furthermore, the KPC-3 Plus

can support up to 26 simultaneously-connected streams. See, e.g., Kantronics, p. 104 (“Any packets sent by other people will not be monitored unless they are also connected to you on another stream.”) and pp. 106-107.

84. Kahn discloses that the source packet radio and its attached device, such as a station comprising a “controller”, sends preformatted messages (i.e., conforming to the layered protocols of the system), which contain “command messages” to the relay(s) and the destination(s). These are sent via the transceiver associated with the source. In Kahn, the control information provides for e.g. routing and acknowledgments, as well as the resetting of operating parameters stored in the packet radios. Kahn also teaches the remote debugging of nodes throughout the system. Kahn, pp. 1488-94; specifically, “By using internet protocols to access the station’s X-RAY process, even the radios can be remotely debugged from the ARPANET” (p. 1494, col. 2). A POSITA would understand that this involves command messages to report stored data (which are formatted for transmission according to the network’s pre-existing protocols), and response messages from the plurality of transceivers containing the requested data (which are also formatted for transmission according to the network’s pre-existing protocols). Kahn also discloses that a microprocessor-based digital unit controls the radio and provides packet header processing (e.g., for routing of packets between nodes). Kahn, p. 1490. As taught generally in Kahn, in a scenario where a

PR needs to send a string of messages to another PR, for which the route is unknown, it will send the first message (packet) to the station that has labeled it (possibly through several repeaters). The station will forward the packet to the destination station, and will also respond to the source station with a message containing a computed route for future transmissions (which could also involve several repeaters). Subsequent transmissions, from the source station to the destination station, take place over that route. This scenario involves command messages from the source PR (e.g., commands for retransmission, forwarding, and request for a computed route), and response messages from a plurality of other transceivers (forwarded packets, acknowledgments, and a computed route).

85. Kahn also teaches that the disclosed system comprises a channel access protocol (CAP) and a station to PR protocol (SPP). Kahn, p. 1490. CAP monitors the hop-by-hop echo acknowledgment process, and retransmission of nonacknowledged packets. SPP is used for reliable delivery of network monitor and control packets, including the “labeling” packets discussed earlier (which are sent to multiple packet radios).

Claim 2

[2a] The system of claim 1, wherein the plurality of transceivers further comprise at least one integrated transceiver, wherein the integrated transceiver comprises:

86. Kantronics and Kahn each disclose the elements of claim 1, as described above, and an “integrated transceiver.” See limitations [2b] and [2c] below.

[2b] one of the plurality of transceivers; and

87. Kantronics discloses that the “integrated transceiver” associated with the tank of liquid is one of the two depicted in the example on p. 167 (one of the plurality). Kantronics teaches that “You can use two (or more) packet radio stations, each containing a Kantronics TNC, to implement remote sensing and/or remote control...” (Kantronics, p. 166). This is an explicit teaching of two or more packet radio stations comprising transceivers; at least one of these (the remote station) comprises a sensor detecting a condition and outputting a sensed data signal (see [2c] below).

88. Kahn discloses that measurement facilities “built into” packet radios “provide for the collection and delivery of measurement data over the radio channel in real-time while an experiment is being run.” Kahn, p. 1495. Because measurement data is delivered “over the radio channel,” a packet radio (comprising one of the plurality of transceivers in the PRNET) comprises both a transceiver and a sensor detecting a condition and outputting a sensed data signal (see [2c] below).

[2c] a sensor detecting a condition and outputting a sensed data signal to the transceiver.

89. Kantronics discloses a sensor detecting a fluid level (a “condition”) and outputting a sensed data signal to the transceiver. For example, the figure on page 167 of Kantronics (reproduced earlier above) indicates a pressure sensor at the bottom of the tank of liquid. This is connected by A/D sensor line 1 to an A/D converter in the KPC-3 TNC, which generates a digital representation of the fluid level (a “sensed data signal”) to the transceiver. Kantronics, pp. 166, 167.

90. Kahn discloses:

“Measurement facilities have been built into the PR and station software. They provide for the collection and delivery of measurement data over the radio channel in real-time while an experiment is being run.” Kahn, p. 1495; emphasis added.

“2) PRU measurement software-collects subnet CUMSTATS and snapshots; enters local data into pickup packets; and periodically sends collected data to station measurement process. **PRU CUMSTATS include counters for packets transmitted, packets received, packets in error, and retransmission histograms.**” Kahn, p. 1495; emphasis added.

91. Thus, Kahn discloses various sensors to collect measurement data. These sensors detect various “conditions” (e.g., the number of packets transmitted and received, the number of packets in error, and retransmission histograms, and output “sensed data signals” to the transceiver for reporting over the RF channel.

Claim 10

[10a] The system of claim 1, wherein the plurality of transceivers further comprise at least one actuated transceiver, wherein the actuated transceiver comprises:

92. Kantronics and Kahn each disclose the elements of claim 1, as described above, and an “actuated transceiver.” See detailed discussion in [10b] and [10d] below.

93. While the specification of the ‘893 patent provides examples of “actuators” that control equipment such as thermostats, and perform on/off system control for climate control systems and alarm systems, the scope of the term is not limited to these embodiments. For example, an RF transmitter can be considered an “actuator” which generates an RF signal; also, the transmit side of a baseband serial I/O port can also be considered an “actuator” which generates an electrical signal in response to data it receives.

[10b] one of the plurality of transceivers;

94. Kantronics discloses a station (one of a plurality) that satisfies both of limitations [10c] and [10d]. The “Remote Station” in the “Remote Sensing and

Control” example comprises a sensor (satisfying limitation [10c]) as well as an actuator (satisfying limitation [10d]). It is one of the two (or more) stations associated with this example. Thus, the “actuated transceiver” associated with the tank of fluid, the fluid level sensor, and the pump and drain, is one of the plurality of a transceivers described in Kantronics.

95. Kahn also discloses a station (one of a plurality) that satisfies both limitation [10c] and limitation [10d]. Specifically, every packet radio unit in the PRNET satisfies both of these limitations (as discussed below).

[10c] a sensor detecting a second condition and outputting a sensed data signal to the transceiver; and

96. Kantronics teaches a sensor for detecting a fluid level and outputting a sensed data signal which is sent to a transceiver. See limitation [2c] above. The fluid level can be associated with a “second condition” (e.g., the level of fluid in the tank). If the claim language is interpreted to require a specific “first condition” different from the “second condition” claimed, there are many other “conditions” that can also be sensed and detected by the remote station. For example, candidate “first conditions” could comprise any of: a) packet received in error; b) packet addressed to some other station; c) acknowledgement received for last transmission; d) timer expiration for acknowledgment of last packet. Thus, Kantronics discloses this limitation.

97. As noted above [2c], Kahn discloses that the packet radios each comprise a sensor detecting a condition and outputting a sensed data signal to the transceiver. Furthermore, each of these packet radios detects multiple conditions (as also noted above). Thus, at least one of the “conditions” identified above can be associated with the claimed “second condition”.

[10d] an actuator controlling a third condition and receiving control signals from the transceiver.

98. In the “Remote Sensing and Control” example, Kantronics discloses that the remote station (the one associated with the “sensor” of limitation [10c]) also comprises two actuators – a pump and a drain – controlling a “third condition” (any of the operational status of the pump, the drain, or the fluid level in the tank). The actuators receive control signals from the transceiver.

99. Kahn discloses numerous aspects of the PRNET that can be remotely-controlled: “From the station, *parameters in each PR and terminal device in the network can be set remotely*, selected elements can be halted, if appropriate, the collection of statistical data from selected devices may be enabled, *traffic sources may be turned on or off*, and data collection may be initiated.” Kahn, p. 1495; emphasis added. In order for traffic sources to be remotely turned on or off, there is an actuator associated with the traffic source that controls the on/off operation (a “third condition”). Because the on/off operation can be controlled remotely from a station, the actuator is also associated with a transceiver and receives control

signals from that transceiver. Thus, Kahn discloses an actuated transceiver as claimed.

100. Furthermore, the operation of a packet radio unit as a repeater represents an “actuator controlling a third condition and receiving control signals from the transceiver” within the meaning of this claim element. The transmitter on/off status is a “third condition” and the transmitter portion of the packet radio unit is “actuated” based on a control signals received via the receiver – i.e., a packet indicating to the PRU (possibly along with other data already stored in the PRU) that it should be retransmitted. A route setup packet is one example of such a packet, already discussed above. Kahn teaches that “each user’s radio might be equipped to support not only his own traffic but that of other designated users. That is, the user’s radio may also have to ‘double up’ as a repeater, to support network traffic.” Kahn, p. 1477, col. 1.

101. Furthermore, the “transmit side” of the terminal/station interface (see, e.g., Kahn, Fig. 13) represents an “actuator controlling a third condition and receiving control signals from the transceiver.” In particular, the “control signals” in this interpretation are the data bits contained in a received packet, intended to be output on the terminal/station interface. The “third condition” is e.g. a high or low voltage level indicating a binary 1 or 0.

102. Should Kahn be interpreted to not disclose an actuated transceiver that comprises a transceiver, sensor, and actuator as claimed, Kantronics discloses that feature as noted above. Kahn and Kantronics are both directed to wireless systems that include a plurality of transceivers which communicate using packet-switching technology. One of ordinary skill in the art would have been prompted to combine the wireless system disclosed by Kahn with the actuated transceiver of Kantronics to result in the claimed system because it is desirable to “use remote sensors and controllers to monitor and automatically respond to system parameters to reach desired results,” as taught by the ‘893 patent itself (see Background discussion including admitted prior art, 1:36 – 2:26). The combination of Kahn and Kantronics results in a wireless control system that solves the problems in the prior art admitted in the ‘893 patent. Moreover, one of ordinary skill in the art could have combined the wireless system of Kahn (its packet radio units and supporting protocols) with the sensors and actuators of Kantronics by known methods with no significant change in their respective functions (Kahn’s packet radio units would still transmit and receive information, including the relay of certain packets; Kantronics’ sensors and actuators would still monitor and control local conditions), yielding nothing more than predictable results without the need for undue experimentation.

103. Furthermore, even without consideration of the teachings of Kantronics, Applicant admitted that it was known to use sensors and actuators to monitor and control automated systems. See e.g., “typical approach” in the ‘893 patent, 1:55-65 and Fig. 1. Kahn represents a computer network that can support real-time interactive communications between computer resources (hosts) connected to the network. Kahn, p. 1469, col. 2. Thus, it would be obvious for a POSITA to replace the PSTN, and the central and local controller of the ‘893 patent, Fig. 1, with the packet radio network of Kahn, in order to support sensors and actuators (and “actuated” transceivers) and achieve the claimed benefits of the ‘893 patent.

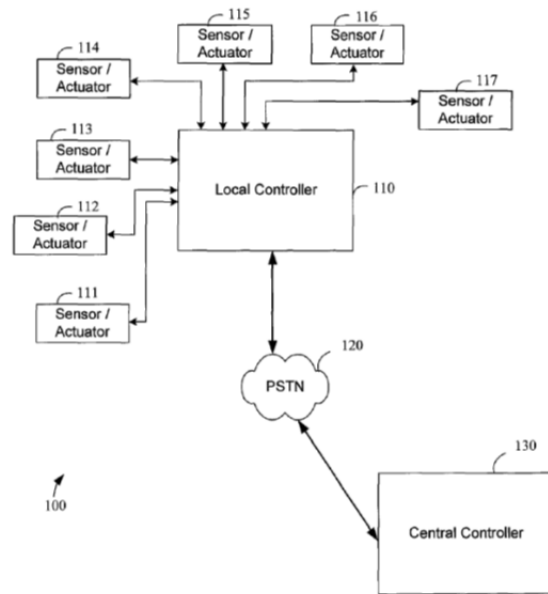


FIG. 1
(PRIOR ART)

CLAIM 37

[37a] A method of communicating between geographically remote devices, the method comprising:

104. Kantronics discloses a method of communicating between geographically remote devices. The method involves the use of a protocol (AX.25) implemented in a plurality of geographically remote radio stations (i.e.,

ham radio stations that are located separately; separate “streams” to multiple stations; digipeater operation with up to 8 digipeaters; and “remote sensing and control” using two or more stations). The method relies on terminal node controllers (TNCs) and radio transmitter/receivers (transceivers); the TNCs can be connected to a computer for local access by a user (Kantronics, p. 19), or operated with only a radio (a transceiver) as a dedicated “digi” (Kantronics, p. 105).

105. Kahn discloses the use of packet radios, implementing packet radio network protocols, to communicate in networks of geographically distributed devices (i.e., devices that are located separately from one another). See e.g., Kahn, p. 1468 (“need to provide computer network access to mobile terminals and computer communications in the mobile environment”); p. 1470 (“For ground mobile radio, network diameters on the order of 100 miles are appropriate...”), and Figs. 9 and 12 (showing radio links over distances in excess of 50 km).

[37b] sending a message;

106. In the general “connected” mode of operation discussed at Kantronics, pp. 101-104, Kantronics teaches that a user can establish a connection (p. 102) by issuing a connect request (p. 103). “Then the TNC will send packets to that specific station and expects acknowledgements in return” (p. 102; emphasis added). Furthermore, a long (multi-packet) message can be sent with the TNC

automatically packetizing the message according to the PACLEN parameter (p. 104) which is user-selectable between 1 and 256 bytes (p. 227).

107. In the “remote sensing and control” example (pp. 166-167), after first establishing an authorized connection to a remote station using the MYREMOTE command and RTEXT protocol (password authentication; pp. 238-240), the user can send a message to the remote station using the ANALOG command (p. 166; pp. 184-185) in order to “gather and report the status of one or two analog input lines in the remote TNC.” (p. 166). “Data can be gathered from a remote site by connecting to MYREMOTE and then issuing the ANALOG command.” (p. 185).

108. Kantronics also teaches the use of digipeater strings (up to 8 digipeaters) with messages sent in sequence through the digipeaters. Kantronics, pp. 105-106.

109. Kahn discloses, among other things, that “A user generated packet with associated addressing and control information in the packet header is input to the digital section of his packet radio, which adds some network routing and control information and *passes the packet to the radio section for transmission* to a nearby repeater which is identified within the packet.” Kahn, p. 1477 (emphasis added); see also Figs. 9 and 12.

[37c] receiving the message at one or more of the remote devices;

110. Kantronics discloses that the packet radio stations receive packets from other stations (“remote devices”). For example, even before attempting to “connect” or send messages to other stations, “If you turn the MONITOR command ON, you will see other people’s packets on your screen.” (Kantronics, p. 103). This demonstrates that packets are being received at one or more of the remote stations. Furthermore, in relation to the discussion of [37b] above, Kantronics discloses that the packet radio stations receive the messages sent in the “connected” mode as well as in the specific “remote sensing and control” example (which is also a connected mode, since the connection to MYREMOTE must be validated). In the connected mode, “your TNC will send packets to that specific station and expects acknowledgments in return” (p. 102). The acknowledgment can only occur if the message is received by the destination station (it must be received error-free).

111. In the “remote sensing and control” example, after the user sends the ANALOG message to the remote station, the remote station must receive it (error-free) in order to respond with the sensed data (a digitized representation of an analog input signal representing a fluid level). If a digipeater string is used to access the remote station (“you can use two (or more) packet radio stations, each containing a Kantronics TNC, to implement remote sensing and/or remote

control,” p. 166), again, more than one of the remote stations must receive the message (error-free) in order for it to be delivered, and thereby allow the remote station to respond with the sensed fluid level.

112. Kahn discloses, among other things, that “*Several nearby repeaters may actually hear the packet*, but only one repeater (which we call the next downstream repeater) will typically be identified to relay it. The other repeaters, will discard the packet.” Kahn, p. 1477 (emphasis added); see also Figs. 9 and 12.

[37d] processing the message;

113. Kantronics, p. 19, discloses that messages generated by a user on his/her computer are “processed” prior to transmission (in the TNC at the sending station), and also after reception at the receiving station(s). In “MONITOR” mode, the receive processing involves delivering the received messages to the monitor in a format that displays the sending and receiving stations. Kantronics, p. 103.

114. In a “connected” mode, the receiver processing includes at least error-checking, parsing of the destination address field to determine if the message is addressed to the local station, and acknowledgments (either explicit, in response to a poll, or implicit). The receiver processing also “determines if the packets need to be resent, then does so if appropriate.” (Kantronics, p. 101, disclosing a summary of the parsing and receiver processing of the extended destination address field to support digipeating).

115. In the “remote sensing and control” example, in response to the ANALOG message received from the central station, and in addition to the processing steps noted above (both at the remote station, and any digipeating stations that may have been involved in the transmission path), the remote station reads the analog voltage from the fluid level sensor (i.e., through the A/D converter) and formats a response message to the central station, in order to report the level.

116. Kahn discloses various forms of message processing:

“Upon correct receipt of the packet, *the nearby repeater processes the header* to determine if it should relay the packet, deliver it to an attached device, or discard it.” Kahn, p. 1477; emphasis added.

“At each repeater, the packet is stored in memory until a positive acknowledgment is received from the next downstream repeater or a time-out occurs. In the latter case, the packet will be retransmitted.”

Kahn, p. 1477.

[37e] preparing a response message;

117. In Kantronics’ connected mode, “your TNC will send packets to that specific station and expects acknowledgments in return” (p. 102). A POSITA would appreciate that an acknowledgement is a response message. Furthermore, in

the ‘remote sensing and control’ example, a POSITA would also understand that the message that reports the fluid level is a response message. See Kantronics, pp. 166-167; 185.

118. Kahn teaches that transceivers from packet radio units can send acknowledgement messages. Kahn, pp. 1477, 90. A POSITA would understand that an acknowledgment message is a response message.

119. Kahn also discloses remote debugging, which involve response messages prepared in response to a request from a different radio node. See discussion of X-RAY debugger, Kahn, p. 1494.

[37f] receiving the response message;

120. In Kantronics’ “connected” mode, a station sending a message must receive an explicit or implicit acknowledgment in order to maintain the connection. If acknowledgment is not received within FRACK seconds (see p. 208), the message will be resent unless a RETRY counter is exceeded (in which case, the connection is dropped and the user is notified). See Kantronics, pp. 102-104 and p. 237. See also the discussion of the AX2512V2 command, and differences between V1 and V2 in relation to handling of “poll” commands, at p. 186.

121. In the “remote sensing and control” example, the control station must receive the response message containing the sensed fluid level in order to determine the proper course of action (i.e., leaving the control signals as they are,

or changing them in accordance with the “OPERATING RULES” indicated in the figure on page 167).

122. Kahn discloses that “At each repeater, the packet is stored in memory *until a positive acknowledgment is received from the next downstream repeater* or a time-out occurs. In the latter case, the packet will be retransmitted.” *Kahn, p. 1477; emphasis added, disclosing receiving the response message.* The remote debugging operation (See discussion of X-RAY debugger; Kahn, p. 1494) also involves “receiving the response message.”

[37g] processing the response message

123. Kahn discloses, among other things, that “At each repeater, *the packet is stored in memory until a positive acknowledgment is received from the next downstream repeater* or a time-out occurs. In the latter case, the packet will be retransmitted.” Kahn⁷⁸, p. 1477 (emphasis added). In order to determine whether or not a positive acknowledgement has been received (and hence whether the packet should remain in memory), the response message is processed. Remote debugging also requires the “processing” of response messages.

124. With respect to Kantronics, in the “connected” mode, a POSITA would appreciate that in order to perform a particular action upon detecting an acknowledgement, that acknowledgement must be processed. In the “remote sensing and control” example, processing the message containing the sensed fluid

level (i.e., in accordance with the operating rules noted above) also satisfies this limitation.

[37h] wherein all messages comprise at least one packet, the packet having a predetermined format;

125. Kantronics discloses the use of the AX.25 Level 2 Version 2 packet protocol. Kantronics, p. 28. The diagram from p. 27 of Kantronics shows the organization of information packets for use in the Kantronics system. The packet format, for a particular packet, is predetermined. Kantronics teaches that all messages comprise at least one packet: “Your packet radio station automatically divides your communication (e.g., a message or file) into small segments... *and puts each segment into its own ‘packet.’*” Kantronics, p. 25, emphasis added.

126. Kahn indicates that packets have a structure as shown in Fig. 8. Kahn, p. 1478. The packets have a predetermined format. Packets consist “of a 48-bit preamble, followed by a variable length header, text, and a 32-bit checksum.” Kahn, p. 1478. Also, “Both the header and text are delivered from the radio section to the digital section *which knows the header format* and can therefore determine the exact start of the text.” Kahn, p. 1479, col. 1; emphasis added. As noted earlier, “the unit of transmission is called a packet”. Kahn, p. 1468, col. 1. Thus, all messages comprise at least one packet having a predetermined format.

[37i] wherein the predetermined format comprises:

[37i.a] a receiver address comprising a scalable address of the at least one of the intended receiving remote devices;

127. See limitation [1e] above.

[37i.b] a sender address comprising an unique address of the sender;

128. See limitation [1b] and [1f] above. “The” unique address of the sending transceiver, as recited in limitation [1f], is also “a” unique address of a transceiver as recited in [1b] and “an” unique address of the sender as recited here in [37i.b].

[37i.c] a command indicator comprising a command code;

129. See limitation [1g] above.

[37i.d] a scalable data value comprising a scalable message; and

130. Kantronics discloses that the predetermined format includes a scalable data value comprising a scalable message such as recently-typed text. For example, the packet depicted on p. 27 of Kantronics has a data section that can vary in size from 1 to 256 bytes. See also PACLEN command, Kantronics, p. 227. In operation (i.e., while conversing with a distant station), two things determine when a packet is sent. Typically, hitting the carriage return or ENTER key will force the TNC to make a new packet with the recently-typed text (the key that

forces a packet transmission can be set with the SENDPAC command). Also, if the user does not “force” a packet transmission in this way, eventually the amount of buffered text will match the PACLEN parameter. This can be set to any value from 1 to 256 bytes (Kantronics, p. 227), and at that point, the TNC will make a new packet even though the ENTER key (or equivalent) was not pressed. See, e.g., Kantronics, p. 104.

131. Fig. 8 of Kahn shows that the header and text section of a packet can be a maximum of 2048 bits. Since the header is 96-144 bits (Kahn, p. 1478), the text portion (a “scalable data value”) represents a “scalable message” that can be up to 1900 bits (approximately), although it could be smaller. A POSITA would understand the use of the word “maximum” in Fig. 8 to indicate that the combination of the header and text could be less than 2048 bits, and that the text portion could be variable in length down to (potentially) zero length. This understanding is reinforced by the additional teaching of Kahn, p. 1470, col. 1, that “The capacity of the packet radio system should allow for *variable length packet sizes up to* a few thousand information bits...” (emphasis added).

132. Furthermore, Kahn teaches that “Any packet may be a route setup packet, subject only to the maximum packet length constraints of the network. A route setup packet *may also* contain data.” Kahn, p. 1482, col. 2, emphasis added. The route setup packet contains the route in the text portion of the message. *Ibid.*

If the set of selectors defining the route is treated as the claimed “data value”, it is clearly a “scalable message” whose length depends on the number of repeaters identified. In the alternative, the statement that “the route setup packet may also contain data” indicates that the non-routing data (the additional text portion) is variable length, since its maximum length would be reduced by the length of the data defining the transmission path; and also, that the additional (non-routing) data might have zero length.

[37i.e] an error detector that is a redundancy check error detector; and

133. See limitation [1i] above. The error detector “comprising” a redundancy check error detector, of limitation [1i], is a redundancy check error detector in accordance with this limitation [37i.e].

[37j] wherein the steps of sending and receiving are repeated until the message is received by the intended receiver.

134. Kantronics teaches a method wherein the steps of sending and receiving can be repeated up to 9 times (considering the source and destination stations as well as up to eight intermediate digipeaters), until the message is received by the intended receiver. Furthermore, in a “connected” mode of operation, a message can be repeated RETRY times (p. 237) if acknowledgment is not received.

135. Kahn shows multi-hop data paths (Fig. 9) and also teaches that:

“If the source device’s PR does not already have a good point-to-point route to the desired destination, it forwards the incoming packets to some station. The station reroutes the packets to their destination, and in parallel, computes a good point-to-point route from the indicated source PR to the destination. It then deposits this route in the source PR, and later packets are routed directly to their destination instead of being routed through a station.” Kahn, p. 1480, *disclosing an end-to-end path with at least two “hops” and one “repeat” of a sending step and a receiving step.*

136. Furthermore, Kahn describes a channel access protocol (CAP) which is responsible for e.g. monitoring the hop-by-hop echo acknowledgment process, and retransmission of nonacknowledged packets. Kahn, p. 1490. Thus, Kahn discloses sending and receiving on multiple hops (which involves at least one successful step of “sending” and one successful step of “receiving” on each hop -- therefore the steps are “repeated”) until the packet is received by the intended receiver.

Statement Under U.S.C. Section 1001 of Title 18

I declare under penalty of perjury under the law of the United States that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code.

Executed this 13th day of July 2015 in Hood River, Oregon.

Respectfully,

A handwritten signature in black ink, reading "Stephen B. Hype", written over a horizontal line.