July 8, 1987 DOC: 802.4L\87-010

DRAFT OF PREPARATION FOR COUNSEL
PETITION FOR RULE MAKING
INDUSTRIAL WIRELESS AUTOMATION SERVICE

Note: This is the type of document that could be given to the attorney who would draft the actual petition document. It assumes events that have not happened, or even been promised; but it does show some of the elements necessary for a successful petition. An important part of the Committee's work is to decide how to deal with FCC considerations; and this paper shows my preference on this matter. -- C. A. Rypinski

OBJECTIVE

The FCC is petitioned to add new rules to Part 90, Subpart D (Private Land Mobile Services, Industrial Radio Services), or elsewhere, covering a short-range, low power data radio service to meet needs for wireless Local Area Networks carrying large blocks of data at high speed for use in factories, hospitals, warehouses, process plants, mines, power plants and other places where the data source or user is not at a fixed location or is often shifted in location. The system could be used in offices, but the need it addresses is not replacement of existing premises wiring in offices.

This Rule Making would promote the standardization of data communication by adding a wireless option to the work of IEEE Local Area Network Standards Committee 802.4 already accepted for factory automation. The petitioners are the Chairman of 802.4 and the Chairman and Vice-Chairman/Secretary of the sub-Committee 802.4 dealing with through-the-air physical medium.

BACKGROUND

This particular Standards Committee (802.4) has chosen to take up this problem, in part, because its access protocol is uniquely suited to radio system applications by virtue of the method used to resolve contention for the medium.

Existing narrow-band services have major functional limitations that make them unsuitable data carrying local area networks. There is too much emphasis on long range, too little data capacity, too long a connection setup time and insufficient probability that a particular attempted use will be successful.

Computer data transfers within a local area occur at a transfer rate of at least 1 megabit/second, the delay before transmission is milliseconds, the link error rate is very low and the aggregate capacity of the link is sufficient for hundreds of low duty cycle users.

The telephone business gives each user a small amount of channel space for a long time--the duration of a connection which is commonly 1 to 3 minutes. **The computer technology gives each user a large amount of bandwidth for a very short time--usually less than 50 milliseconds; and there is no radio service now defined which serves this philosophy.**

The product of bandwidth by time used for Computer terminals is generally smaller per computer than per telephone allowing more users per MHz with suitable system design. The creation of a suitable service will enable a more intense usage (in terms of number of users) of radio frequency space than any prior system known to the petitioner.

The technical possibility is based on non-interfering co-use with another service. This is possible because of the use of transmitter power levels which may be less than 1 milliwatt. The low power becomes practical when there is a high physical density of mobile stations (one per hundred square feet of floor space) and very short distance between the mobile station and the serving fixed equipment (500 feet maximum--200 feet typical). Instead of trying to get solid coverage by overpowering the system sufficiently to fill shadows with bounced and bent waves, diversity is usable with many fixed sites so that one sites shadow is another sites light.

By using the new technology to reduce cost of fixed sites used at very close spacings, it is possible to work with transmitters of such low power that possibilities of interference too other users of the frequency space can be made very small.

The petitioner does not seek exclusive space, priority over existing users or guarantees that existing users with higher power transmitters will not cause interference.

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The data system user who receives interference will have to place his fixed stations at shorter distance intervals to obtain greater relative signal level.

An example system plan is offered. It uses the IEEE Local Area Network Standard 802.4 Token Bus protocol. The plan is intended to serve areas from 100,000 ft^2 to one square mile with a cellular pattern of interference limited frequency reuse. This plan is for example only to show the engineering effort to meet economic and functional objectives. The characteristic achieved is a 2 Mbs duplex LAN with a bit error rate at the terminals of better than 1 in 10^6 using microwave frequencies and less than a milliwatt of transmitter power.

The Rule Making sought should not be limited to this or any other system, but rather should allow any system with equivalent energy density per MHz and with margin for the gap between calculations and practice. Moreover, a permitted system should offer the possibility of many hundreds of user stations in a small area or it does not serve the intended function.

POSSIBLE APPLICATIONS

There is no concept of the radio system filling all communication needs--this is impossible. The radio system does not replace building wiring, however having a small fraction of the data (and possibly voice) communication capacity in wireless form will be valuable. Nonetheless, the preponderance of applications are thought to be within buildings or other large premises controlled by a single entity and partly shielded or otherwise isolated from the community. Examples include large factories, power plants and hospitals.

There are a large number of possible applications, however only a few are described:

Factory Automation

Large factories are increasing the use of mobile robots for moving parts and inventory to the production line. There are reasons for having assembly machines move with the line so that the duration of each operation can be set independently for each process. There are vehicles guided by wires and their radiated fields buried in the floor. It is no longer satisfactory for the instructions for each of these machines to be built or hand loaded.

It is critical to the efficiency of these plants that the cost of changeover and adaptation to different models be minimized. Expressed in another way, the capabilities of one line must be broadened to react very quickly to changed product specifications and types. The time and cost of these changes is far less if there are a minimum of fixed and bounded devices involved.

Part of the solution is a ubiquitous wireless data network where computers can download the instructions for each moving machine, robot or guided vehicle unit by unit on the production line. These instructions are becoming increasingly complex containing sometime the information shown in large manufacturing drawings. The transfer time and total system capacity is only reasonable with megabit rates in the transmission medium.

This service is an essential part of growth in productivity in large factories. It is believed that this assertion will be verified by qualified entities speaking in support of this petition.

Hospitals

Hospitals are changing. It is well known that the use of electronic means for diagnostics, monitoring and some types of treatment has grown greatly in recent years. At the same time there has been an immense increase in the record keeping responsibilities of these organizations. In the past, a very large part of the cost of health services is in keeping continuous records of patient treatment and in archiving these records in compliance with legal requirements.

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The labor of Nurses and other health care professionals has become a scarce asset which is poorly used when diverted to record keeping. It will become possible for a larger portion of this information to go directly from the source to the computer without intermediate pieces of paper.

There is a problem of setup time on expensive, new patient related electronic equipment. If the equipment plots measurements versus time or if it makes pictures of any kind, the data generation for archiving requires the megabit data rates of Local Area Networks (LAN). Older Hospitals have great economic difficulty in placing an outlet for LANs in every possible place where new equipment might be used. Even new Hospitals find that the architect did not think of every possible place, as for example on the rolling bed/stretcher.

If medical machines and terminals had no hookup problem--they just work when they are turned ON--a significant increase in efficiency in staff utilization is possible. The hookup to wall outlets may seem simple, but it has given problems and limitations. A good solution is a ubiquitous wireless data network available anywhere in the building providing capacity and speed of delivery far beyond telephone wires and PBX.

The petitioner believes that this assertion will be confirmed by qualified institutions in support of this petition.

Mines, Power Plants and Places Temporarily Uninhabitable

There are places that become temporarily or permanently uninhabitable due to noxious atmosphere, radiation or uni-directional access. The conduct of the work to rectify problems cannot be carried by persons, but must be done by machine. That machine needs more data to control and originates more data from optical and other sensors as its complexity grows. It is forseeable that some machines will be used in numbers.

This frequency space would provide a generalized capability for large numbers of such machines with very large data communication requirements.

TECHNICAL REQUIREMENTS

Common to Mobile and Fixed

Frequency range (F1 to F2):
1850 to 1990 MHz
Number hopping frequencies (H):
80 Minimum
Maximum bandwidth of channel (BW) at -6 dB (F2-F1)/H:
1.75 MHz
Minimum separation of hop frequencies:
BW
Occupancy of one frequency by one transmitter maximum:
100 millisec
Out-of-band radiation:
-30 dBc

Fixed Transmitters

Peak output power:
200 microwatts (note 1.)
Transmit duty cycle--one frequency:
1/80th maximum
Maximum antenna power gain:
20 dB maximum

Mobile Transmitter

Peak output power:
200 microwatts (note 1.)
Transmit duty cycle--one transmitter:
1/80th
Maximum length of one transmission:
100 milliseconds
Maximum antenna power gain:
7 dB

Note 1. Value for outdoor operation. Upon showing of special conditions, such as operation entirely within a building offering shielding loss to interference with other systems, power levels 10 or 20 dB greater should be authorized on a case-by-case basis.

An example of a usable set of technical requirements is shown above which assumes co-use of channels now used largely for terrestial point-to-point microwave, and which, in the opinion of the petitioner, would rarely experience harmful inter-system interference. **The new service does not expect or require assurances of freedom from interference from existing users.**

These frequencies are now used by private systems. If the use were to be by common carriers, a different choice would have been made.

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The petitioner observes that these frequencies are recognized for fixed/mobile use on the international table for Region 2.

From a number of specific plans, the IEEE 802.4L standards committee has approved a plan, which if acceptable from a regulatory criteria, would also be acceptable to a wide group of organizations interested in furnishing equipment or using the capability described.

This plan is attached as Exhibit A; and it is a plan which fits within the constraints above. It contains considerably more detail than would be appropriate within an initial Rule Making. This document also contains descriptions of the purposes achieved by many of the specific properties chosen.

LICENSING AND/OR CERTIFICATION

The petitioner suggests that use of Manufacturer Certified equipment be sufficient for use of power levels up to 1 milliwatt peak output. Power levels up to 20 milliwatts should be permitted with Type Accepted equipment used by licensees.

USAGE AND PUBLIC INTEREST

The penetration of this type of equipment in th market could be estimated at 3 years after first availability. 1% of all data terminals with interfaces at 9.6 kbs or higher would use wireless transmission if it were available.

If the Controller for a manufacturing cell (cluster of machines under common control) is a mini-computer, on the average 5% of the stations will benefit from wireless connections. It is more likely that 5% of the controllers will be mostly wireless stations.

In a Hospital, all major electronic machines attached to a patient will be more useful if the data port is served by wireless and usable whether stationary, moving or just moved. Many other machines and terminals relating to inventory control, issue of materials, nurses records and doctors access to data base could benefit from wireless data ports; and the penetration might be 25% of all such terminals in use.

Within 5 years after availability, it is likely that several million ports on terminals, machines and computers would be served by wireless given reasonable regulatory access and economically acceptable technology. Several million of additional ports might be exported if the designs incorporate the highest levels of tooled technology that can be foreseen in this time frame.

The economic significance of these numbers is not easily estimated. One large value would be avoidance of high cost, one-at-a-time solutions now used for unavoidable instances of this type of need. It cannot be estimated how high the cost is for poor equipment utilization due to lack of portability.

The petitioner believes that Rule Making providing for an INDUSTRIAL WIRELESS AUTOMATION SERVICE with the capacity, operating spectrum, power limits and applications described would assist in the continual increase in industrial productivity in the United States; and it would do this without loss to the co-users of the spectrum space proposed.

Several of the organizations which are represented on IEEE 802.4 have indicated that they will make their own filings in support or otherwise directly in their own name.

Respectfully submitted,

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