

CableLabs

Cable Television Laboratories, Inc.

Stephen D. Dukes
Director
Advanced Network Development

October 21, 1992

Dr. Thomas P. Stanley
Chief Engineer
Federal Communications Commission
2025 M Street, N.W.
Washington, DC 20554

Dear Sir,

PCS Experimental License KM2XAT
Your File 3034-EX-PL-92

Our first quarterly report, covering the period ended September 30th, is attached. Subsequent quarterly reports will be filed within 30 days of the end of each calendar quarter.

Yours truly,



Stephen D. Dukes

Enclosure

cc: Dorothy Gill Raymond, Esq.
Richard H. Strodel, Esq.

October 21st, 1992

CABLE TELEVISION LABORATORIES, INC.
PCS EXPERIMENTAL LICENSE
FIRST QUARTERLY REPORT

GENERAL

This is the first quarterly report by Cable Television Laboratories, Inc. (CableLabs), under experimental license KM2XAT, covering the period ended September 30th, 1992.

This license was awarded by the FCC (Federal Communications Commission), effective June 10, 1992 and expiring January 1, 1994.

This report also covers experiments under FCC Special Temporary Authority (STA) KS2XAB, which was effective March 11, 1992.

Copies of these licenses are in Appendix A.

CABLELABS' INTEREST IN PCS

CableLabs is a research and development consortium of North American cable television operators. Its members provide service to 85 % of the cable television subscribers in the U.S.A. and 60 % of those in Canada. Among its members are the leading cable television operators in these countries.

One of the programs at CableLabs is the investigation of the integration of cable and radio technology to provide PCS (personal communications services). It seems likely that, by making use of the pre-existing broadband cable infrastructure which cable operators have in place in many localities, PCS could be brought to the public readily and economically.

As part of this program, CableLabs is using portions of the radio spectrum to evaluate and demonstrate PCS radio technologies in a cable environment.

ACTIVITIES COVERED BY THIS REPORT

The following activities are covered in this report:

1. Set-up and demonstration of Remote Antenna Driver (RAD) technology on CableLabs' in-house cable television system.
2. Propagation measurements at CableLabs' offices.
3. Evaluation of cable transmission technology for PCS backhaul.
4. Preparations for subsequent activities.

Remote Antenna Driver Initial U.S. Demonstration

The RAD Concept. -- The Remote Antenna Driver (RAD) concept originated with Rogers Communications Inc. It was first demonstrated by Rogers Cablesystems Limited (a

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CableLabs member), and has been in use for more than a year in their PCS field trials in Vancouver and Toronto.

In the U.S., the RAD concept has been evaluated and demonstrated by Time Warner Telecommunications and by Cablevision Systems, both of which are also CableLabs members active in PCS activities. Other CableLabs members have plans to evaluate and demonstrate the RAD concept in the U.S., and interest in the RAD concept is being shown by U.S. manufacturers.

The RAD concept is outlined in Appendix B.

These trials have demonstrated the feasibility of the RAD concept. Because of the great promise of the RAD concept for cable-based PCS, CableLabs and Rogers are in the process of negotiating an agreement by which CableLabs will share in ownership of the concept and will make it readily available to the U.S. cable industry.

Setup of the Initial U.S. Demonstration. -- The first demonstration of the RAD concept in the U.S. was performed by CableLabs on April 2, 1992. One RASP (remote antenna service point) and two RADs were set up on CableLabs' in-house cable television system at 1050 Walnut Street, Boulder. The equipment was manufactured by Nexus Engineering. The test arrangement is shown in Figure 1.

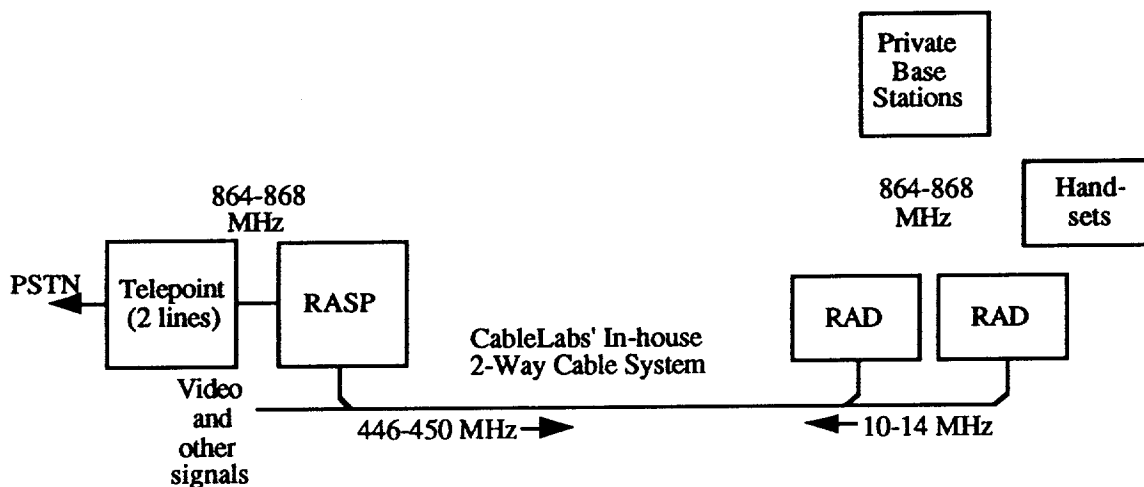


Figure 1 -- Initial RAD test arrangement.

The in-house cable system consists of a headend, located on the 5th floor, a trunk and feeder system in the laboratory next door to the headend, and a distribution system covering offices and conference rooms on the 4th and 5th floors. This system conforms to modern practices and is used to evaluate and demonstrate cable technologies and practices.

The RASP was set up in the headend room and was connected to the start of the in-house cable system. Two Ferranti CT2 single-channel Telepoint units were colocated with, and connected to, the RASP. Each Telepoint was provided with a 2-wire loop directly connected to the local public switched telephone network (PSTN).

The cable system configuration for this test was 9 trunk amplifiers and 2 line extenders, and included a total of about 9500 feet of coaxial cable. The amplifiers were powered over the cable. This was set up in a corner of the laboratory.

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The cable system bandwidth for the test was 50-550 MHz in the forward path and 5-30 MHz in the return path. During the test, the cable system carried 40 channels of television, as well as other signals normally found on a cable system in commercial service. This configuration emulates the coaxial portion of a modern fiber-to-the-feeder cable television system.

The two RADs were set up, for convenience, near each other in the laboratory. They were connected to the last tap on the cable system. The RADs, RASP and Telepoints were set up for correct levels on the cable system and antennas.

Four Ferranti CT2 handsets and two Ferranti private base stations were available for the test. The air interface on this equipment conforms to U.K. Department of Trade and Industry specification MPT 1334, and is similar to the CT2 CAI (Common Air Interface) specification MPT 1375.

The CT2 equipment operated in the band 864.1-868.1 MHz. The RASP and RADs were configured to use the band 446-450 MHz on the cable in the forward direction, and 10-14 MHz in the return direction.

The setup and alignment took place without incident.

Initial Demonstration. -- When this was all set up, Dr. Richard R. Green, CableLabs' President and CEO, used one of the handsets to successfully call Richard S. Leghorn of Eidak Corporation in Boston, who was the founding Chairman of the CableLabs PCS Subcommittee (a committee of CableLabs member companies which reviews and advises on CableLabs' PCS activities). A few other calls were made subsequently.

There was no evidence of incompatibility between the PCS signals and the other signals on the cable system.

This was the first RAD-based PCS call on cable television plant in the U.S. In addition, the cable distance over which the call took place remains one of the longest, for CT2, up to now in the U.S. (CableLabs has plans to demonstrate longer distances, as indicated later below.)

This test setup has been dismantled, in order to allow the in-house system to be used for other tests, and to permit the RASP and RAD equipment to be reworked for future PCS tests.

Propagation Measurements

A few test calls were made to determine the extent of CT2 coverage within the CableLabs offices on the 4th and 5th floors, and tentative future locations were selected for the two RADs so as to provide coverage of these offices.

Cable Transmission

Another possible arrangement for providing cable-based PCS coverage is to transmit the PCS voice signals over the cable to the locations where the PCS base stations are placed. CableLabs plans to evaluate and demonstrate such an arrangement. In preparation for this, CableLabs began an evaluation of suitable cable transmission equipment on its in-house cable system. No radio equipment has been added to this evaluation yet.

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Preparations for Future Activities

CableLabs made arrangements to secure CT2 CAI equipment. An order was placed on Motorola. Some of this equipment will operate in the 902-906 MHz band, and the rest of it will operate in the 1921-1928 MHz band. This will enable comparisons to be made of the differences in propagation characteristics in the two bands in and around CableLabs.

CableLabs has also made arrangements with Nexus to rework its RASP and RAD equipment to include equipment updates that were suggested by the experience of other CableLabs members to date, and to operate at 902-906 and 1921-1928 MHz. This will enable comparisons to be made of the differences in RAD behavior in the two bands.

In addition, CableLabs has ordered two 902-906 MHz microcell extenders from Nexus. These devices operate like RADs, but without any frequency translation, so that the PCS r.f. signals pass over the cable on their original frequencies. This will enable comparisons to be made of the two technologies.

CableLabs has also ordered from Nexus a modified CT2 base station and RASP which will be independent of cable distance. With this equipment, CableLabs will demonstrate that the cable distance limitation of TDD (time-division duplex) radio technology can be overcome. The means of overcoming this limitation is by making use of the FDD (frequency-division duplex) characteristics inherent in the cable plant. By extending the FDD operation from the cable plant through the RASP into the base station, the distance limitation can be overcome.

CableLabs is also making arrangements for radio equipment other than CT2 to be included in the experiments. This will include FDD as well as TDD technologies, and CDMA (code-division multiple access) as well as TDMA (time-division multiple access).

CableLabs is planning to evaluate the operation of various types of base stations when connected to various types of cable transmission equipment, as outlined earlier above.

SUMMARY

The activities to date by CableLabs and others indicate that cable technology is suitable for the economic provision of PCS.

APPENDIX A
COPIES OF EXPERIMENTAL LICENSES

APPENDIX B

REMOTE ANTENNA DRIVER CONCEPT

The RAD (Remote Antenna Driver) concept allows significant economies in the deployment of low-power wireless Personal Communications Services (PCS), and also facilitates deployment which is timely and well-matched to evolving service coverage requirements.

The RAD concept improves upon conventional PCS technology by allowing the PCS base stations to be collected together at central points, such as fiber nodes and head ends, where scale economies can be realized in base station accommodation and sizing. Please refer to Figure 1. The antennas, on the other hand, are placed where radio coverage is needed, remote from the base stations (hence the name "Remote Antenna Driver"). The cable television system supplies the base station/antenna connections. The RADs can be physically integrated with the cable television infrastructure, and can be powered from the cable, allowing further economies compared with conventional PCS technology.

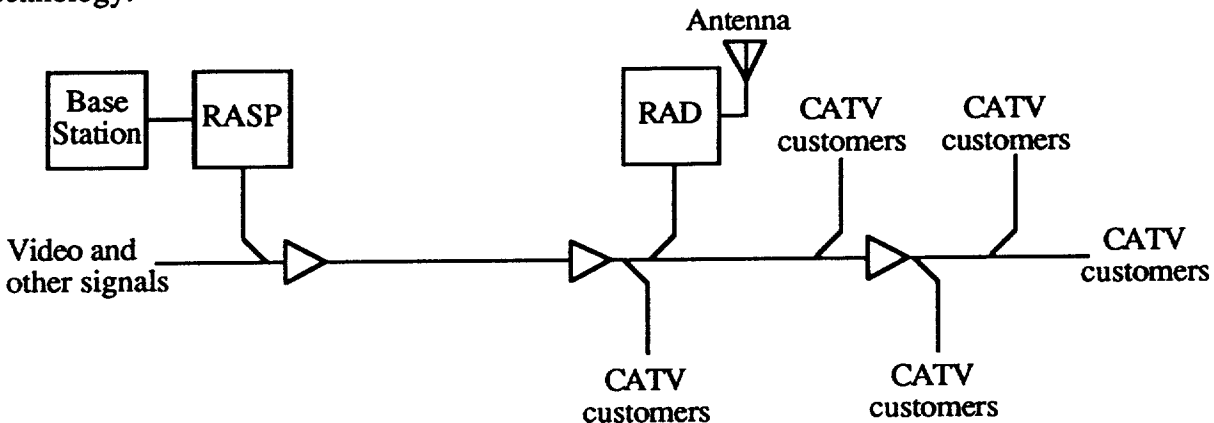


Figure B-1. Base station, RASP and RAD

This is how it works. Please refer to Figure B-1. Consider first the downstream path from the base station to the antenna. The base station is a collection of PCS transmitters and receivers. These are connected to the cable system through a RASP (Remote Antenna Service Point). The RASP translates (shifts) the transmitted signals, from the frequency on which they would normally have been transmitted to the air, to a vacant frequency band in the downstream passband of the cable television system.

The translated PCS signals are carried down the cable television system, together with the video and other signals that are normally present.

At the location where PCS coverage is needed, an antenna is placed. The antenna is connected to the cable television system through a RAD. The RAD re-translates the PCS signal back to the original frequency that was transmitted by the base station. After filtering and amplification, the re-translated PCS signal is applied to the antenna and radiated. The net effect is the same as if the base station were located right at the antenna.

A similar process operates in the reverse direction. Incoming PCS signals are picked up by the cell antenna and are fed to the RAD. The RAD removes out-of-band signals by filtering, amplifies the remaining signals, and translates them to a vacant frequency band in the cable system reverse

passband, where they are carried back to the RASP location. This implies activation of the return cable path in systems where it is inactive.

The RASP re-translates the signals arriving from the RAD, back to their original frequencies as they were received by the antenna. The base station receivers process these signals the same as if they were actually at the antenna location.

It is feasible to equip more than one RAD connected to the same RASP, as shown in Figure B-2, thus forming a distributed antenna. In this way, the range limitations of a single antenna can be overcome. This will be of considerable importance in effectively matching the number of base station transceivers to traffic requirements in the early days of service, when demand will be low, and in low-traffic areas.

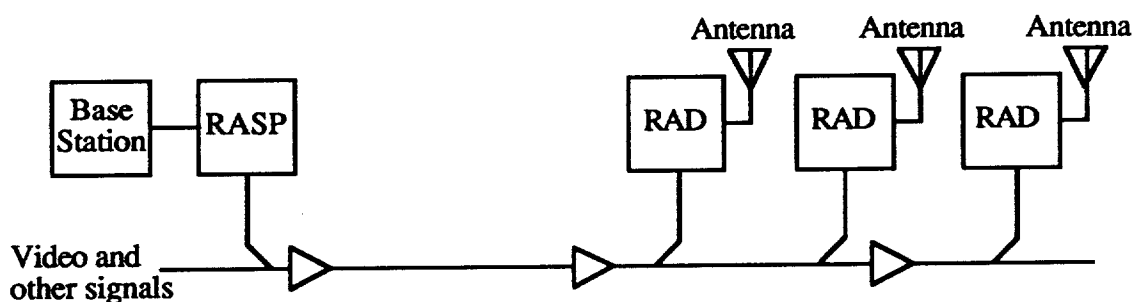


Figure 2. -- Multiple RADs forming a macrocell

It is also feasible to equip different but parallel RAD paths on the same cable television system, as shown in Figure B-3. This allows multi-RAD distributed antenna systems to be segmented as traffic grows. It can also accommodate multiple PCS service providers, and diversity paths.

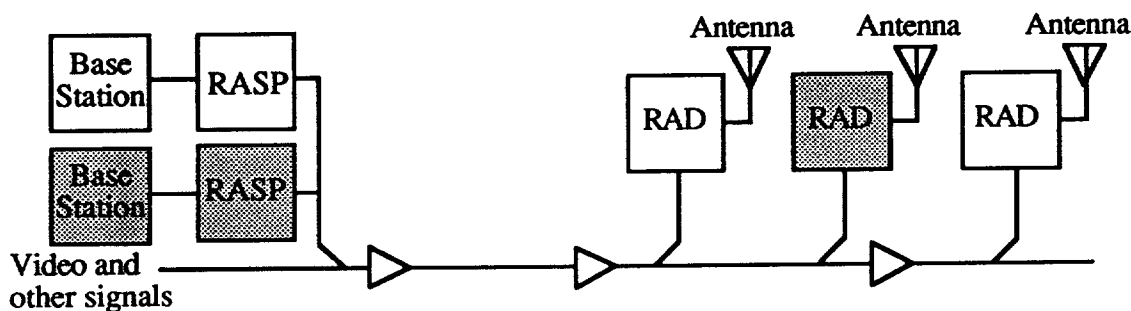


Figure B-3. -- Parallel RAD paths

RADs have been constructed and demonstrated using the CT2 standard, but they can also be constructed for other air interface standards, for example AMPS cellular, and various TDMA and CDMA standards.