

**IEEE P802.11**  
**Wireless Access Method and Physical Layer Specifications**

**DIGITAL CORDLESS RADIOTELEPHONES**  
**SUMMARY OF CANADIAN TESTS TO DATE**

**Contact Address:**

Walt Sonnevile  
Sonneville Associates  
314 Wye Mill  
Gaithersburg, MD 20879  
301-869-4460 (Voice)  
301-330-3671 (Fax)

The Licensees, Test Period and Basic Objectives

Eleven companies have been licensed by Canada's DOC (Department of Communications) to conduct technical and marketing tests of 10 mw (ERP) digital cordless radiotelephones. Licenses were granted May 1989 with all testing to be concluded by September 1, 1991. The tests will be operated at 864.150-868.150 MHz. Canada expects to allocate 944-952 MHz for commercial service, which may begin in 1992.

The objectives of these tests are to demonstrate the performance and marketing success potential for voice telecommunications using digital cordless handsets in public-access ("Telepoint") commercial service and in private-access residential and workplace environments. Data tests are not planned, so far as is known, although moderate data transmission capabilities have been cited as required in the view of recommendations issued by a "Services Definition" subcommittee within the Radio Advisory Board of Canada (RABC).

The eleven companies authorized to conduct these tests are:

B.C. Mobile - (British Columbia Mobile)  
BCE Mobile Communications (Bell Canada Enterprises)  
Bell Canada (the telephone company subsidiary of BCE)  
Bell Northern Research (the development lab for Northern Telecom)  
Cantel (a nationwide cellular operator)  
GlenNet Network Services (Glenayre--a Canadian manufacturer)  
Motorola Canada  
NovAtel (a Canadian cellular manufacturer)  
SaskTel (Saskatchewan Telephone)  
Telesat Mobile, Inc. (affiliated with Telesat--the satellite co.)  
The Telezone People (affiliated with Toronto's The Beeper People)

Data from companies licensed to conduct similar tests in the US are not yet available. As of February 6, 1991 there were 51 companies who submitted 54 applications for testing digital cordless radiotelephone equipment in the US. Of these, 26 had been granted. Almost all US tests will be conducted in the 900 MHz and 2 GHz bands, involving FDMA, TDMA and CDMA digital technologies. (Canadian tests will be FDMA and TDMA, with limited CDMA testing planned after September 1991.)

Products Tested

Handsets and base stations tested in Canada through December 1990 were made by rival suppliers Ferranti (UK) and Shaye Communications (UK). Their equipments, introduced commercially about mid-1989, are FDMA products typically referred to as "CT2" (for second-generation cordless telephone).

Also tested was the first North American production of the Ericsson CT3 TDMA equipment, made under license by Canada's NovAtel. CT3 equipment (for third-generation cordless telephone) had been first

released for a test in the Netherlands which began September 1990. Called the DCT-900 handset (for Digital Cordless Telephone at 900 MHz), the unit is said by Ericsson to be based on the anticipated standards for the European Telecommunications Standards Institute's "DECT" (Digital European Cordless Telecommunications) which, beginning with its commercial availability in 1993, will provide a platform for both portable voice and data services. However, because of frequency-band differences and spectrum availability, CT3 at 4 MHz spectrum (862-866 MHz) offers only 32 channels at 125 KHz, while DECT at 20 MHz (1880-1900 MHz) will offer 120 channels at 166 KHz channel bandwidth.

There are major distinctions also between the lower-cost CT2 and the higher-costs CT3 and DECT. For example, the latter two offer hand-off and user locator (two-way origination in public places) and are said to be ISDN compatible.

Other CT2 handsets and base stations are available from GPT and Orbitel (both UK). Motorola-Canada plans to announce, late February or early March 1991, its CT2 handset, said to weigh only 6.5 ounces complete with two batteries. A built-in pager is optional. Bell Northern Research and Northern Telecom, allied subsidiaries under BCE (Bell Canada Enterprises), are working on a "CT-2 Plus" product which will have more features than CT2 and should have stronger appeal to office applications while remaining flexible for public-access use.

The accompanying photo shows three handsets, designated "new" (CT2 from Shaye), "newer" (CT3 from Ericsson), and "newest" (a PCN handset design under consideration by Mercury, a PCN licensee in the UK. PCN, for "Personal Communications Network," is based on digital cellular standards using a hybrid microcell/macrocell architecture).

#### Test Data From Two Licensees: SaskTel and Cantel

Several Canadian licensees have conducted tests through the end of December 1990 yielding worthwhile data. They are SaskTel (with NovAtel), Cantel, BCE Mobile, and the Telezone People. Test results by two of these--SaskTel and Cantel--are summarized here.

SaskTel tested CT2 and CT3 late 1990 at the 18-acre site of the Regina Exhibition Grounds, which has 12 acres of building ground space. Of particular interest here is the CT3 (Cantel data are summarized for test performance of the CT2). The two SaskTel-provided maps show, first, coverage over the exhibition grounds using six base stations and, secondly, coverage within one building only (the Agribition Building, which measures about 400 x 700 feet). CT3 equipment, which provided two-way call origination with handoff, was used as a wireless adaptor connected to an existing PBX through an "RFP" (Radio Fixed Position). CT3 was designed primarily for PBX applications.

Each RFP has a 16-pin screw terminal connector along its lower edge for connection to the shielded cable. This cable carries the message data stream, as well as RSSI (Received Signal Strength Indicator),



**NEW**



**NEWER**



**NEWEST**

antenna switching information, control data, and the power necessary for the RFP itself. As a result, no additional cable/connections are required to the RFPs.

SaskTel suggests that the location of RFPs be as high as possible above floor level to clear any office obstructions. RFPs should be located to allow for sufficient overlapping coverage to allow for RFP diversity as well as antenna diversity.

Cantel tested Ferranti CT2 handsets in 14 large shopping mall main corridors throughout Canada. Both technical tests and focus-research market interviews were conducted. In addition, technical tests were held at two large "assembly" buildings (one stadium and one convention center) and at the executive offices of Cantel in North York, Ontario.

Radio coverage testing was achieved by installing a base station in the test area and connecting the telephone interface to a source of audio. An engineer set up a call from a handset to the base in the normal manner and then roamed the test area listening to the audio.

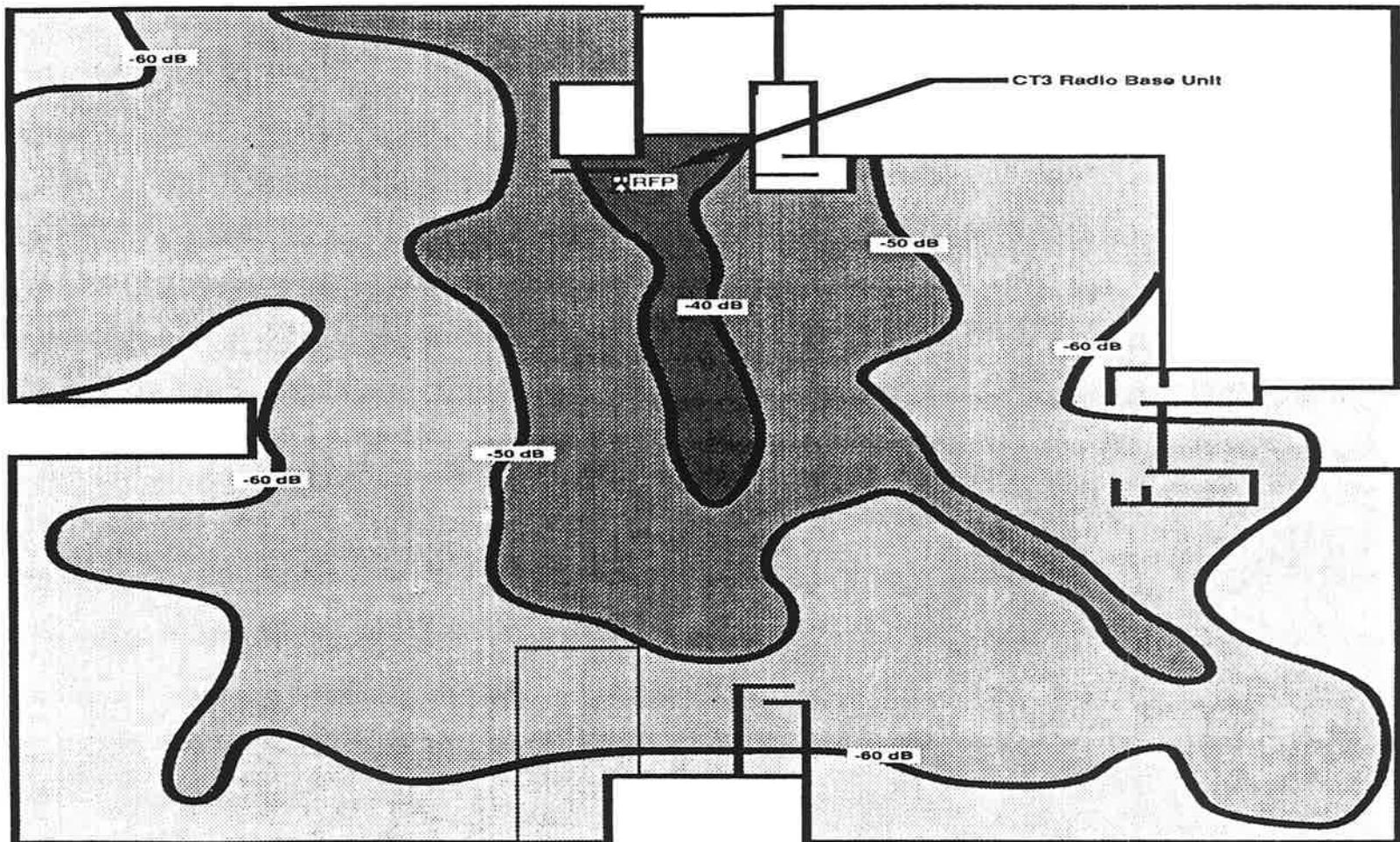
A numerical receptivity rating was assigned to a number of discrete locations within the test area, using a ranking analogous to the CCITT "subjective quality" rating for telephony. The accompanying maps show receptivity for six numerical ratings (i.e. zero through five).

The Ferranti (and Shaye) equipment is designed to provide a radio link of acceptable quality with a Bit Error Rate (BER) of  $10^{-3}$  or less. A new call will not be set up unless the BER is less than  $10^{-3}$ . Cantel found that the coverage range for an established call is larger than the coverage range for a new call set-up. Typically, the radius of coverage is 20% larger for the former than for the latter.

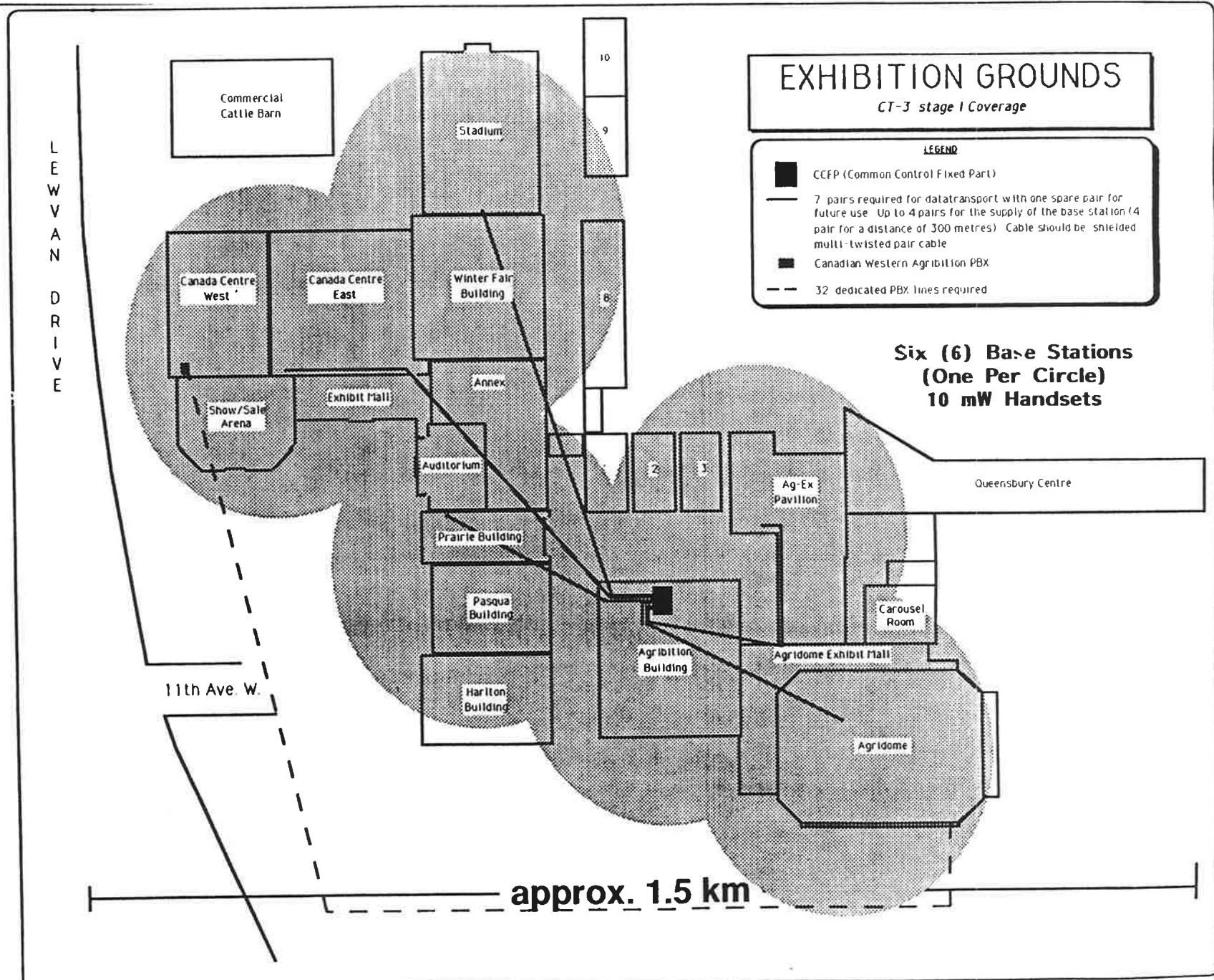
Cantel found that use of diversity antennae on the base station, with as little as 85 mm spacing between antennae, provides a substantial improvement in performance. Radio coverage in indoor environments is not affected to a large degree by antenna type (directional versus non-directional or gain versus unity gain), nor by antenna orientation or polarization.

Audio coverage is typically "digital" in nature; i.e., it is either good within the coverage area or, outside the coverage area, there is no communications. The area of transition at the edge of the coverage area is quite distinct. In this area the audio is "switched" on and off as the BER moves above and below the threshold of  $10^{-3}$ . There is no gradual increase in noise and distortion, as one might experience in an analog system.

If the user is walking out of the radio coverage area and the audio begins "switching" on and off as the result of the BER increasing, the user may stop walking and move the handset slowly while listening to the earpiece. With a slight motion the audio will be restored. This technique is readily and instinctively learned.

**AGRIBITION BUILDING  
RSSI MEASUREMENTS**

- All measurements in dB
- Antenna elevation: 3.4 m above floor level
- Output power: 10 mW



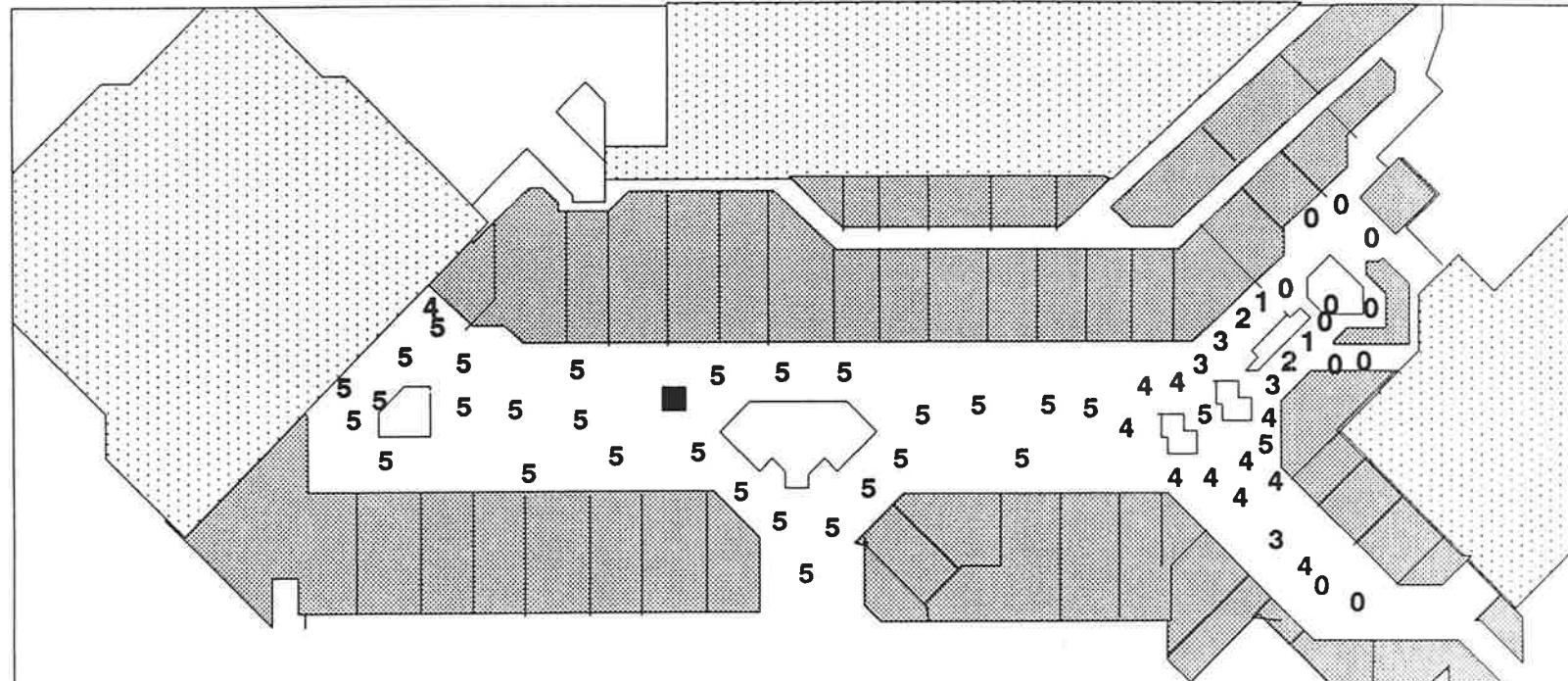
Cantel concluded, after this first round of tests, that existing CT2 equipment can provide adequate coverage and excellent call quality in indoor situations. However, measured real-world performance falls short of manufacturers' claims. As improved hardware becomes available from a variety of suppliers, direct comparisons will be made.

The four accompanying maps of Masonville Place, a shopping center in London, Ontario, show radio coverage on each of two levels using an omni-directional antenna versus a directional antenna. Maps of each of the five levels of Place Montreal Trust (maps not provided here), another shopping center, show excellent radio coverage on the major pedestrian arteries on all five levels when the single base station is located on the second level near the common open level.

All maps provided in this paper were prepared by Cantel and SaskTel.

**Test location : MASONVILLE PLACE, LONDON** (1680 Richmond St. North. This structure has two levels. Signal coverage was similar on both levels due to numerous common openings.)

LEVEL 1



OMNI-DIRECTIONAL ANTENNA TEST

RADIO COVERAGE LEGEND

- 0 No radio coverage
- 1 Fringe radio coverage
- 2 Marginal radio coverage
- 3 Consistent radio coverage
- 4 Very good radio coverage
- 5 Excellent radio coverage

- Indicates placement of base station.
- ◀ Indicates outside entrance.

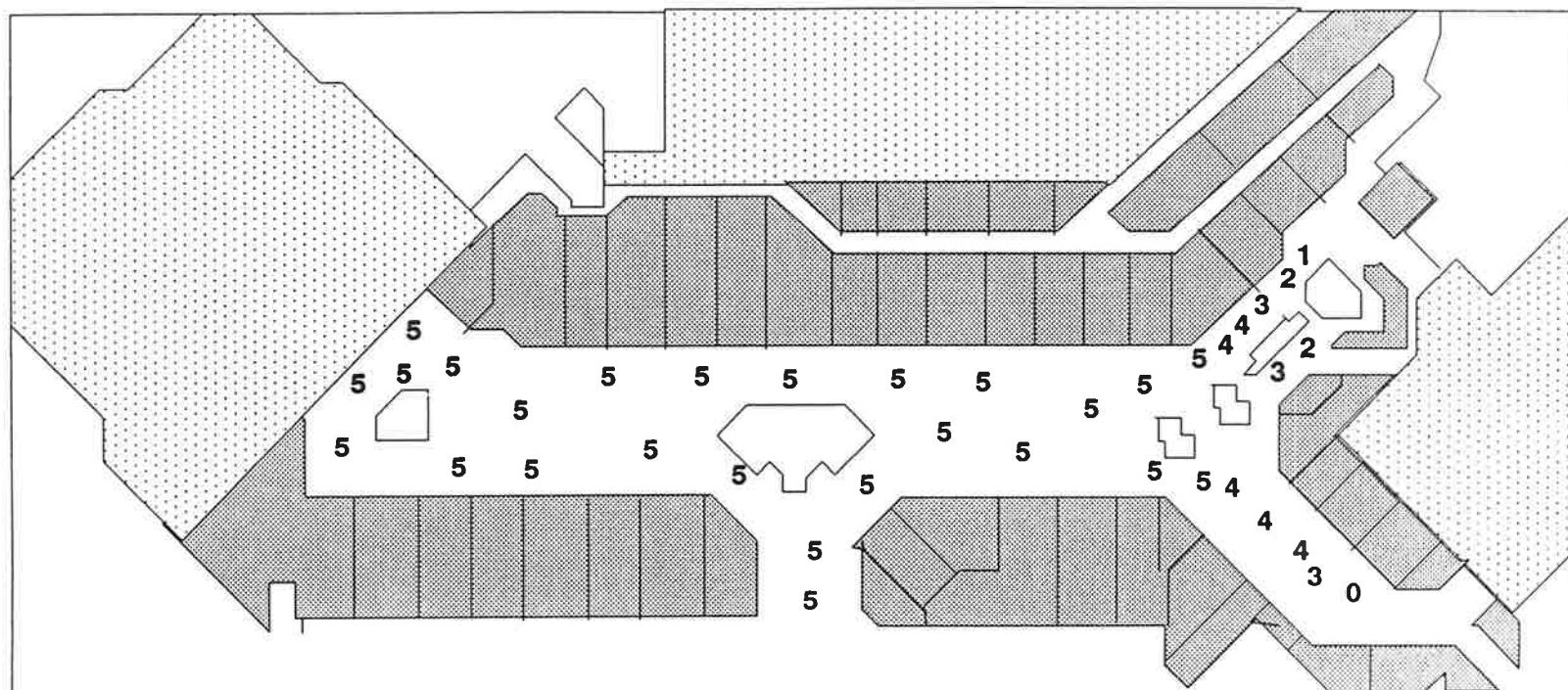
\* NOT TO EXACT SCALE



Cantel Personal  
Communications

## Test location : MASONVILLE PLACE, LONDON

LEVEL 1



### DIRECTIONAL ANTENNA TEST

#### RADIO COVERAGE LEGEND

- 0 No radio coverage
- 1 Fringe radio coverage
- 2 Marginal radio coverage
- 3 Consistent radio coverage
- 4 Very good radio coverage
- 5 Excellent radio coverage

- Indicates placement of base station.
- ◀ Indicates outside entrance.

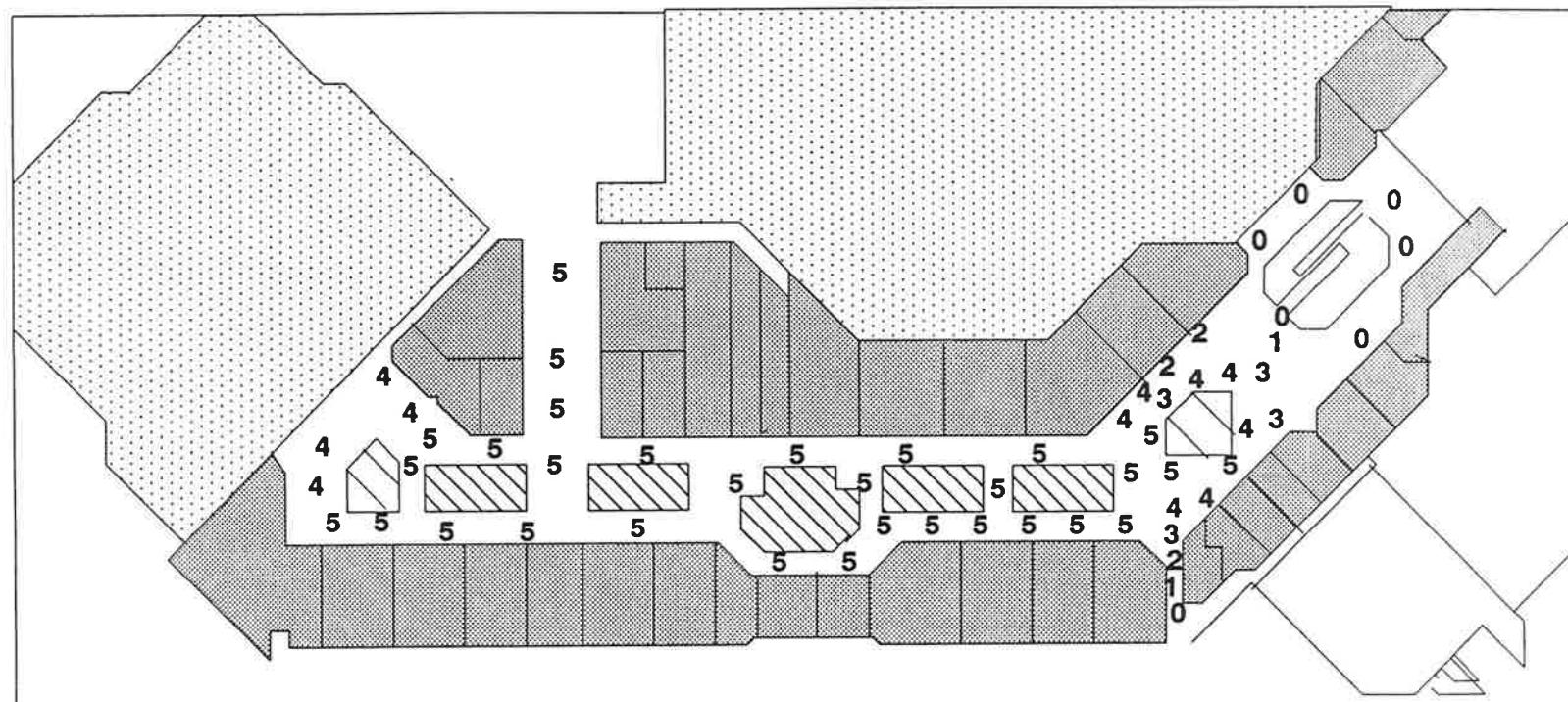
\* NOT TO EXACT SCALE

**CANTEL®**

Cantel Personal  
Communications

## Test location : MASONVILLE PLACE, LONDON

LEVEL 2



### OMNI-DIRECTIONAL ANTENNA TEST

#### RADIO COVERAGE LEGEND

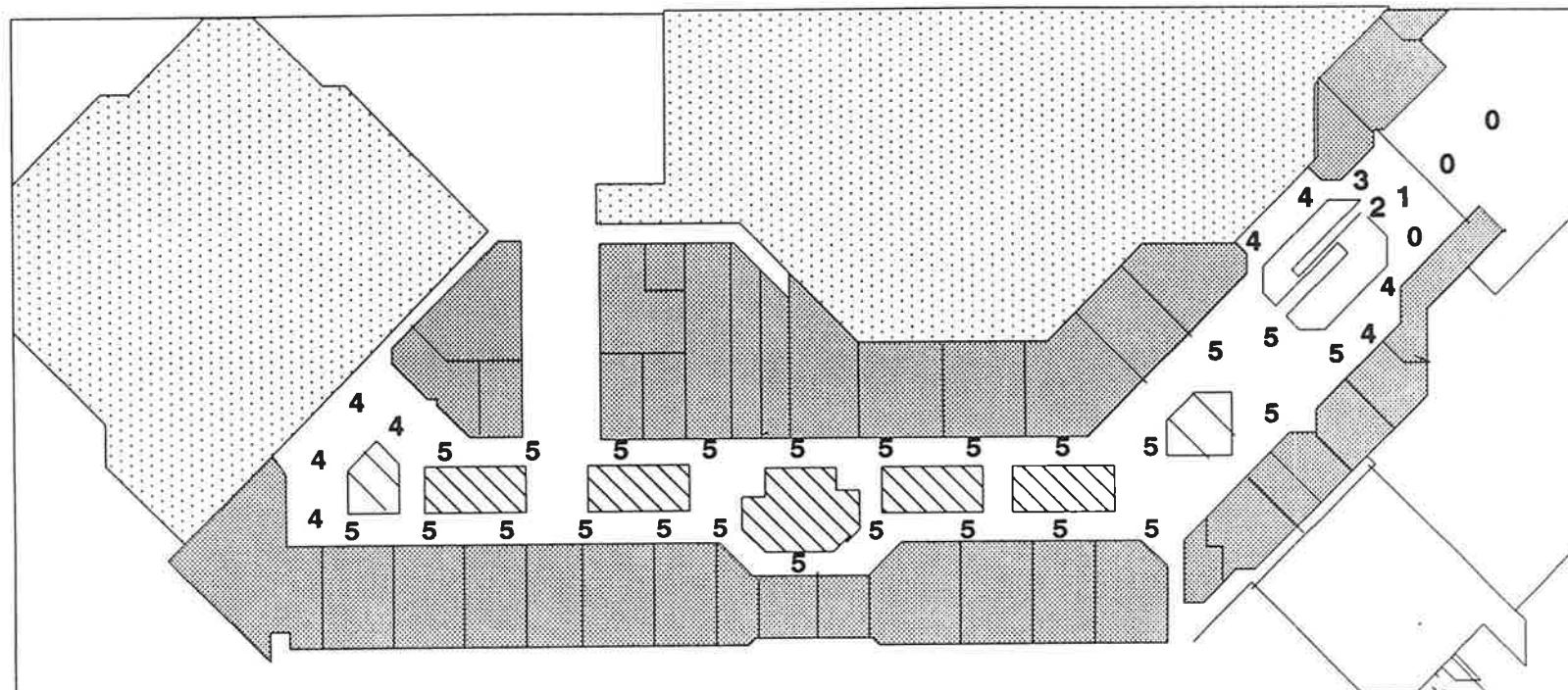
- 0 No radio coverage
- 1 Fringe radio coverage
- 2 Marginal radio coverage
- 3 Consistent radio coverage
- 4 Very good radio coverage
- 5 Excellent radio coverage

- Indicates opening to level below.
- Indicates placement of base station.
- Indicates outside entrance.

\* NOT TO EXACT SCALE

**CANTEL®**

Cantel Personal  
Communications

**Test location : MASONVILLE PLACE, LONDON****LEVEL 2****RADIO COVERAGE LEGEND**

- 0 No radio coverage
- 1 Fringe radio coverage
- 2 Marginal radio coverage
- 3 Consistent radio coverage
- 4 Very good radio coverage
- 5 Excellent radio coverage

- ◻ Indicates opening to level below.
- Indicates placement of base station.
- ◀ Indicates outside entrance.

**\* NOT TO EXACT SCALE**

Cantel Personal  
Communications