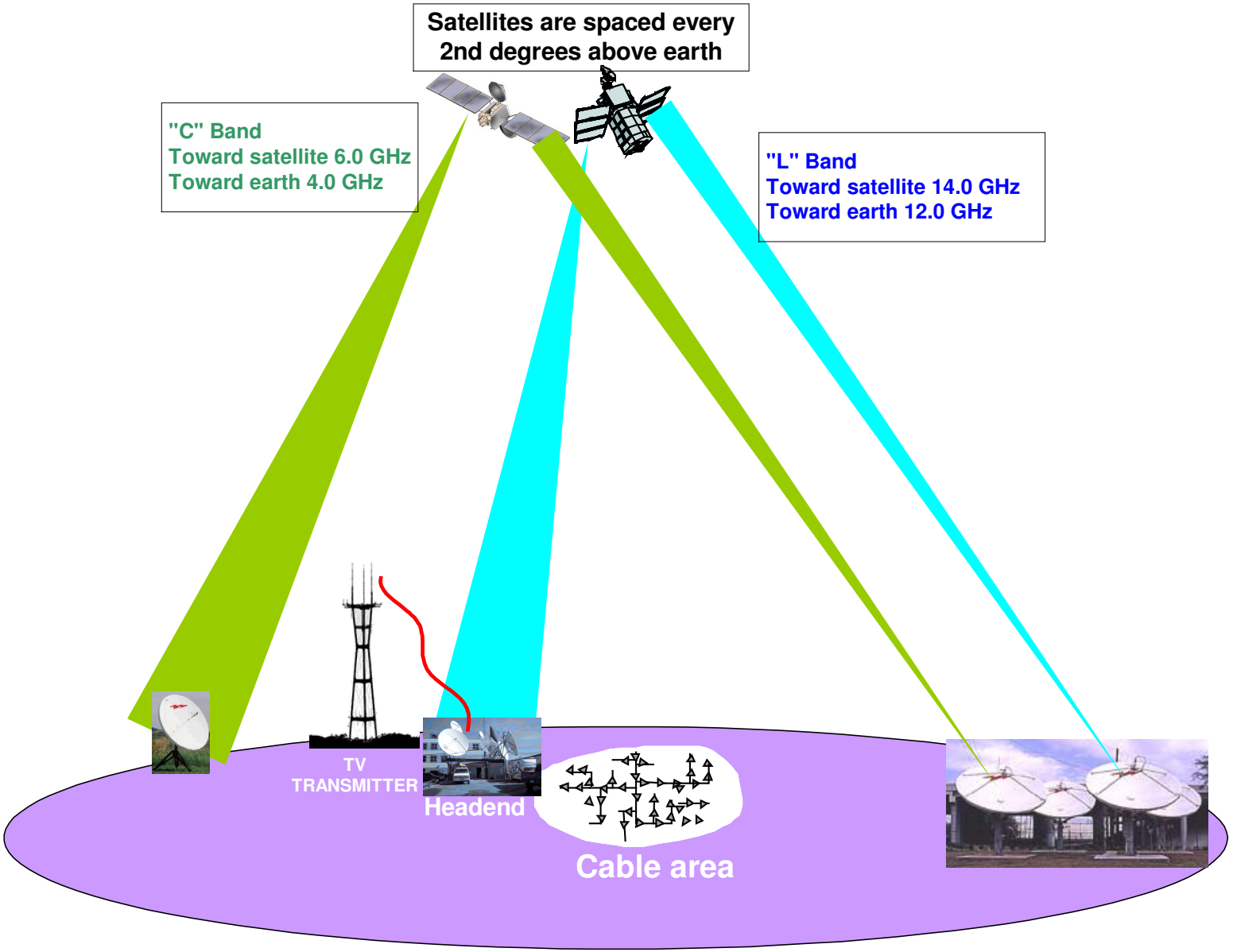
Broadband System – O



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CLI Cumulative Leakage Index

Cumulative Leakage Index

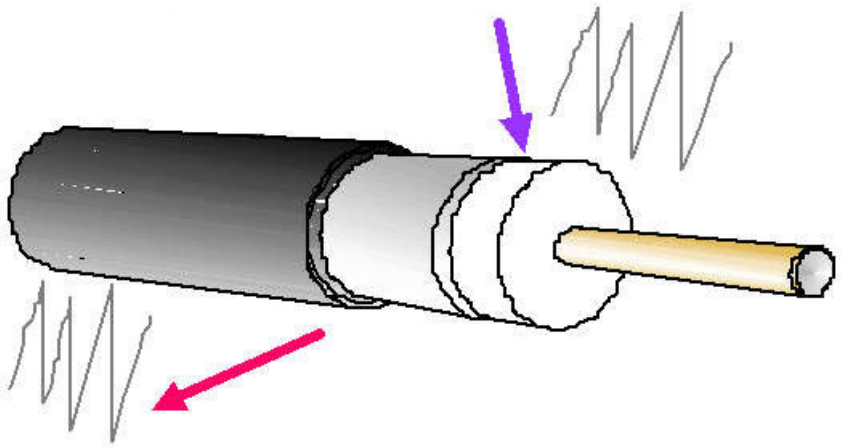
Leakage Terminology

- Radiation.
- Egress
- Ingress
- Leakage
- uV M (Micro volts per Meter)
- CLI (Cumulative Leakage Index)

Ingress / Egress

Ingress:

RF signal leaking into the coaxial plant.



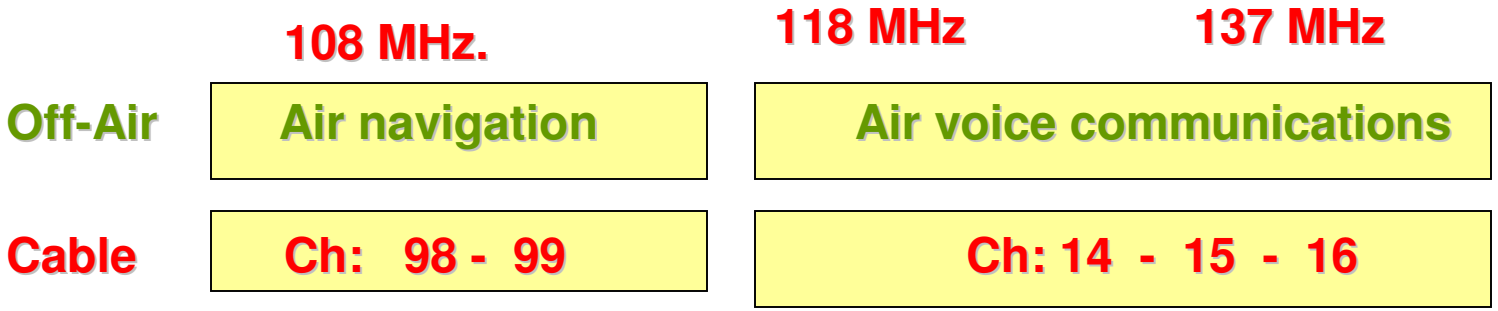
Egress:

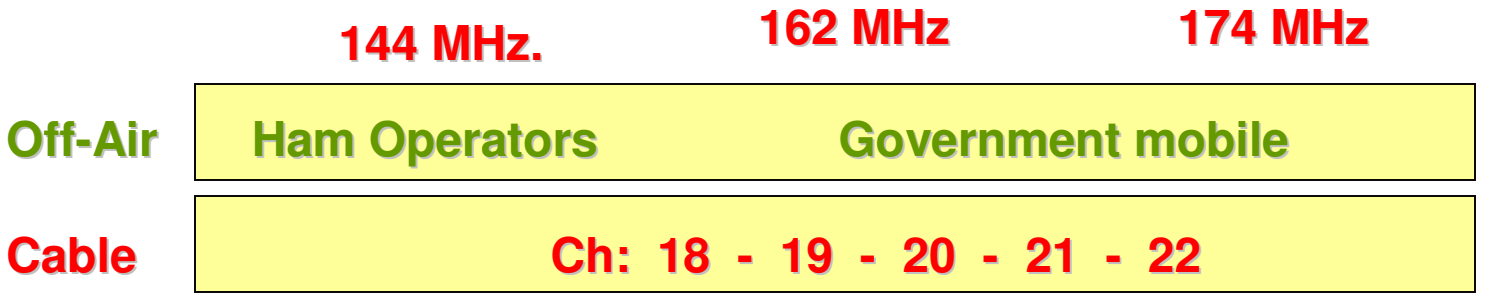
RF signal leaking out of the coaxial plant.

Reasons to monitor leakage

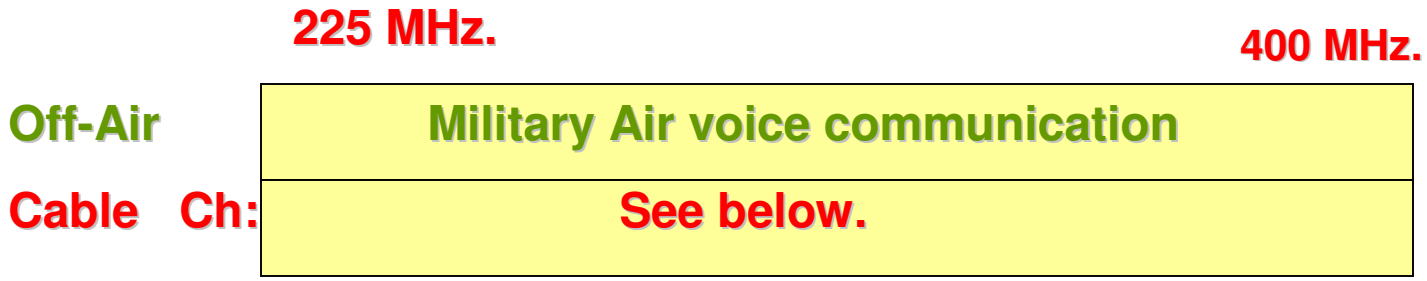
1. Prevent Off-Air Broadcast Interference.
2. To meet government compliance.
3. To give our customer better quality of signal.

Spectrum Charts





Spectrum Charts



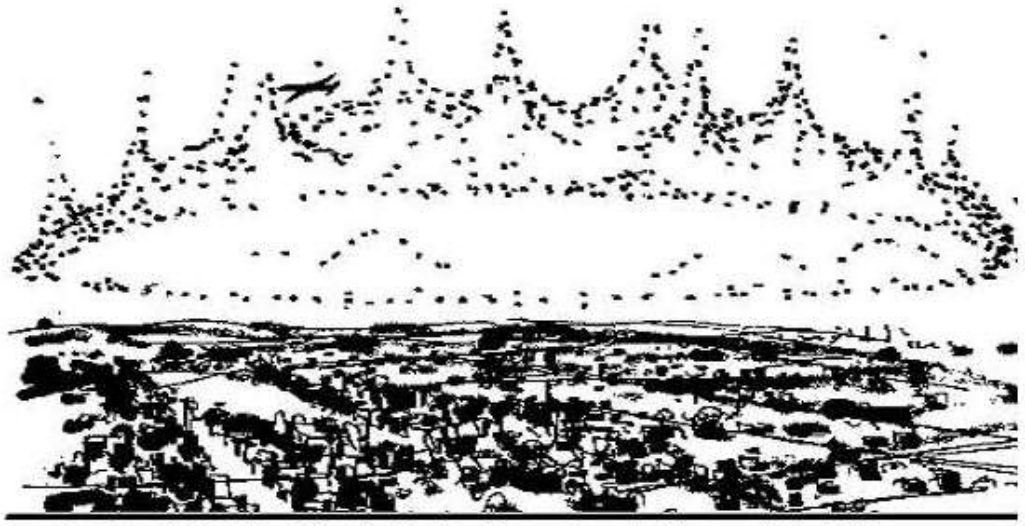
- 155.34 MHz - Nationwide Hospital / Ambulance Radio Link
- 156.80 MHz - Marine Emergency Aircraft Survival Locator.
- 243.00 MHz - Emergency Aircraft Survival Locator.

Signal Leakage History

- Mid-band expansion.
- Aeronautical interference discover (1976)
- Frequency offsets (1979)
- Radian dome (1980)
- Mandatory FCC / DOC enforcement (1980s)
- Cumulative Leakage Index (1990)

Cumulative Leakage Index CLI

CLI is the net effect of the combination of all the leaks in the system added together.



These cumulative leaks form an invisible cloud of unwanted RF energy over the cable system.

CLI Rules (Quarterly)

- Ride out 100% of system and log all leaks.
- Log should include Date found and Date fixed.
- Documenting leakage level isn't required for this drive out.

- ***Actual practice for your system may vary!***

CLI Rules (Annually)

- **Ride out 75% of the oldest part of the system and log all leaks location and measured level.**
- **Must be performed within a reasonable period of time *(Usually within 2 wks of due date)***
- ***Actual practice for your system may vary!***

The only acceptable procedure for leakage measurement by the government rule.

- Use a calibrated half wave dipole antenna.
- Antenna must be elevated 3 meters off the ground and positioned 3 meters from the leakage source.
- Antenna must be rotated 360° in the horizontal plane for maximum reading.

Required actions.

- All leaks above 20uV/m must be logged and fixed.
- Only leaks above 50uV/m are used in CLI calculation.
- All measurements taken outside 108 – 137 MHz must be converted as if they were taken within the band.

uV/M (Microvolts per Metre)

- Standard unit of measure for CLI

- 50 Ohm off air measurement.

- Voltage developed in 1 meter of infinitely, this section of wire submerged in a leakage field produces 1uV of energy.

C.L.I.

- Cumulative Leakage Index.
- Mathematical summation of leakage in a system designed to approximate the interference to aircraft flying overhead.
- Figure of merit for system performance.
- One leak of 1588uV/M within a system is enough to fail C.L.I.

Cumulative Leakage Index.

$$10\text{XLOG}\left[\left(\frac{\text{Total Plant}}{\text{Miles Driven}}\right) \text{X} \left(\text{sum of Leak}^2\right)\right]$$

Compliance = 64 leaks or less.

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3.2 Leakage Control

3.2.1 At all times, cable system operators should strive to minimized emanating from their facilities.

3.2.2 The operator of a cable television system distributing signals over supplementary channels must carry out a systematic patrols to detect leakage, and take corrective measures to prevent leakage.

3.2.3 The operator of a cable television system must keep a logbook indicating the date and location foe each leak detected, the date on which it was repaired and its probable cause. This logbook must be kept for a period of two years so that it may be examined by an inspector from the Department upon request.

3.2.4 When leakage originates from a subscriber's premises, the system operator must ensure the necessary repairs are carried out. If such repairs cannot be effected within a reasonable period of time, the operator must stop distribution of the interfering service(s) or channel(s) to the subscriber's premises until the leakage can be repaired. *In addition, distribution of interfering of service(s) or channel(s) to subscriber's premises must be stopped immediately if the leakage originating from the subscriber endanger safety services (ambulance, police, aeronautical frequencies, and so on)*

BP-23 for Canadian Operator.

4.1 General Provisions

4.11 Unless indicated otherwise, all technical standards stated herein apply to the requirements respecting performance between the cable television system input and any subscriber terminal.

4.1.2 All technical standards specified herein relate to the measurement procedure discussed in this document, and, where appropriate, apply in the presence of all signals usually carried on the system.

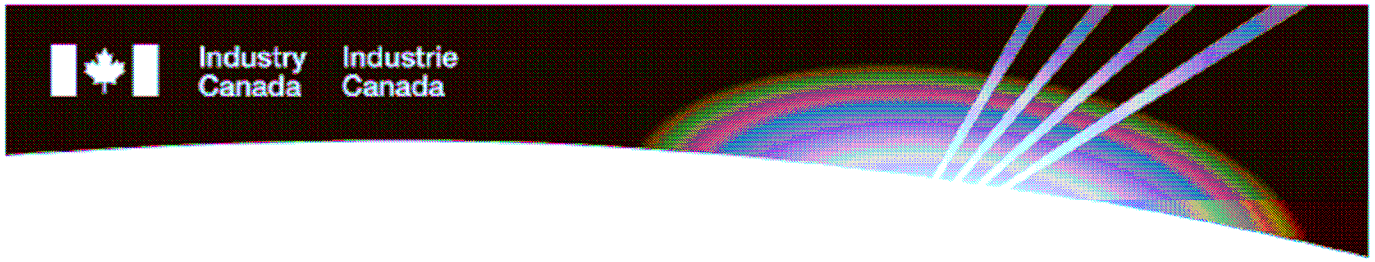
4.2 Leakage Criteria

4.2.1 The following leakage criteria are used to evaluate cable system leakage performance.

4.2.2 The Equivalent Leakage Density estimates the impact of signal leakage on land-based radio system- I.e. police, ambulance service, etc.- which share spectrum with cable television systems. The ELD criterion ensures that all cable systems meet a leakage performance intended to minimize interference to land-radio system.

4.2.3 The Cumulative Leakage Index (CLI) estimates the cumulative impact of leakage on aeronautical spectrum users. When the signal leakage measurements are taken on the ground, the CLI ground-based criterion (CLI_g) is used. If the measurements are taken in the airspace above the cable system, the CLI air-based criterion (CLI_a) is used to estimate this impact. Both criteria apply to cable system carrying A-1(99), A-2(98), EE941) and FF(42)

BP-23 for Canadian Operator.



BPR Part 8
Issue 1
June 2005

Spectrum Management and Telecommunications

Broadcasting Procedures and Rules

Application Procedures and Rules for Broadcasting Receiving Undertakings (Cable Television)

http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/vwapj/bpr8e.pdf/$FILE/bpr8e.pdf

You can get this procedure at the above internet link

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4.3 Equivalent Leakage Density (ELD)

For the purposes of calculating the Equivalent Leakage Density, leakage readings are classified into three categories, each of which has it corresponding weighting factor, as shown in the table below.

Leakage Category (µV/m at 3 metres		Weighting Factor
A	50 - 200	1
B	201 - 500	2
C	> 500	3

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4.3.2 The ELD is calculated using the following formula:

$$ELD = \frac{(N1 \times 1) + (N2 \times 2) + N3 \times 3),}{K}$$

where:

ELD = Equivalent Leakage Density

N1 = Number of leaks in Category A (50 – 220 uV/m)

N2 = Number of leaks in Category B (201 – 500 uV/m)

N3 = Number of leaks in Category C (>500 uV/m)

1 = Category A weighting factor

2 = Category B weighting factor

3 = Category C weighting factor

K = Number of kilometres patrolled.

4.3.3 For the purposes of ELD calculations, only leaks equal to or grater than 50 uV/ at 3 metres need to be taken into account.

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4.4 Equivalent Leakage Density Application Schedule.

Table 4.2 shows the ELD limits applications schedule. The beginning of the first implementation period coincides with the effective date of this document. Cable systems will have to the end of each implementation period to reach the ELD limit that applies for that period. The maximum limit after 6 years is 0.8.

Implementation Period (years)	Maximum ELD Limits at End of Implementation Period
0 - 2	1.4
2 - 4	1.1
4 - 6	.8

BP-23 for Canadian Operator.

4.5 CLI Ground-Based Criterion (CLI_g)

4.5.1 The computed CLI_g must not be over 64.

4.5.2 The CLI_g is calculated using the following formulas:

$$CLI_g = 10 \log \left\{ \frac{S}{D} \sum_{i=1}^{N} E_i^2 \right\} + F(S)$$

$$F(S) = 10 \log \left\{ \frac{91}{S} \left[\log \left(1 + \frac{S}{28} \right) \right] \right\}$$

Where:

CLI_g = CLI ground-based criterion, taking into the surface area of the system

$F(S)$ = Correction factor for the surface area

E_i = Filed strength of the i^{th} leak measured at 3 metres, in uV/m

S = Surface area covered by the cable system in km^2

N = Number of leaks detected

4.5.3 While all leaks, regardless of magnitude, must be repaired, it is not necessary to take into account leaks of less than 50 uV/m at 3 metres when calculating the CLI_g

BP-23 for Canadian Operator.

4.6 CLI Air-Based criterion (CLI_a)

The CLI_a is the 90^{th}-percentile value of the field strength due to cable leaks and it must not exceed 10 microvolts per metre RMS at an altitude of 450 metres above the cable system's average ground level.

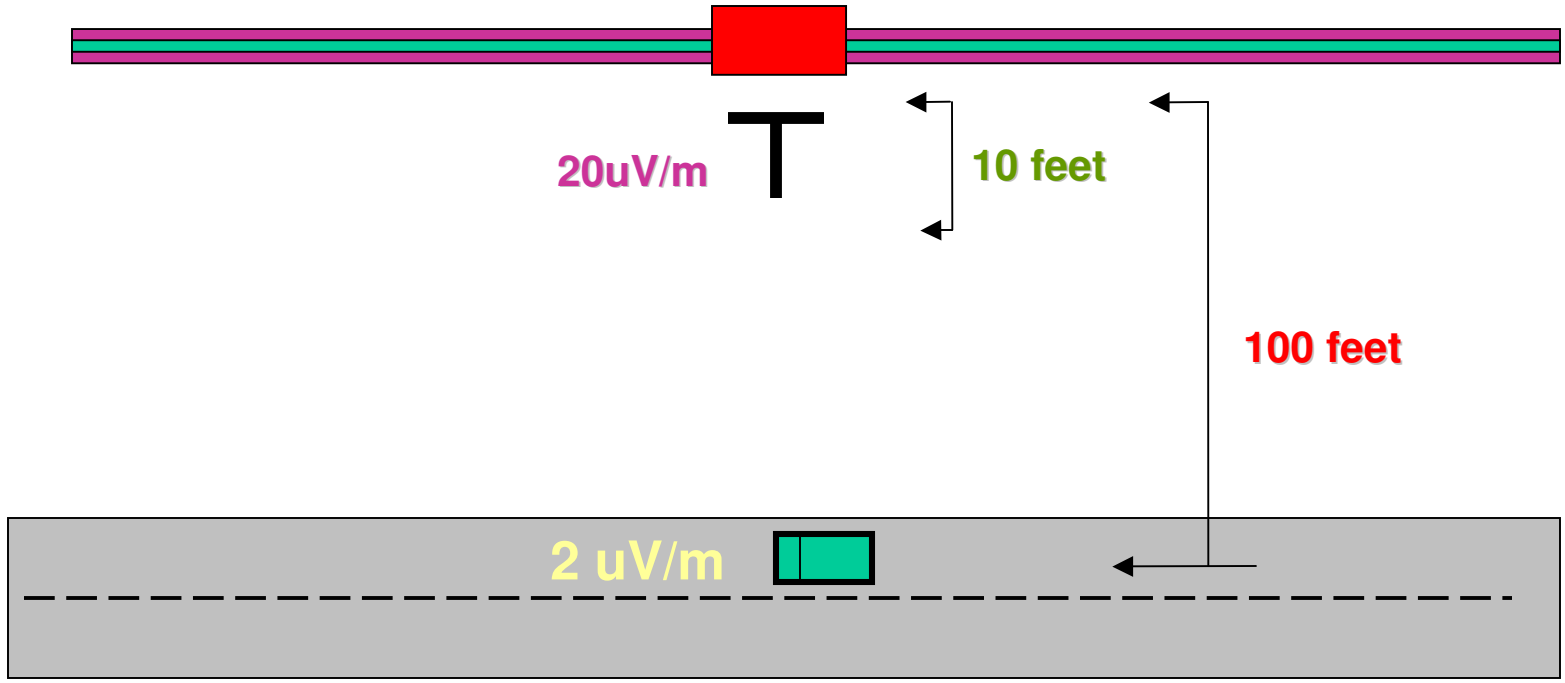
4.7 Carrier-to-Noise ratio

The carrier-to-noise ration for each television channel received at any subscriber terminal must not be less than 40 dB.

The full BP-23 can be downloaded at the internet address below:

http://strategis.ic.gc.ca/SSG/sf01209e.html

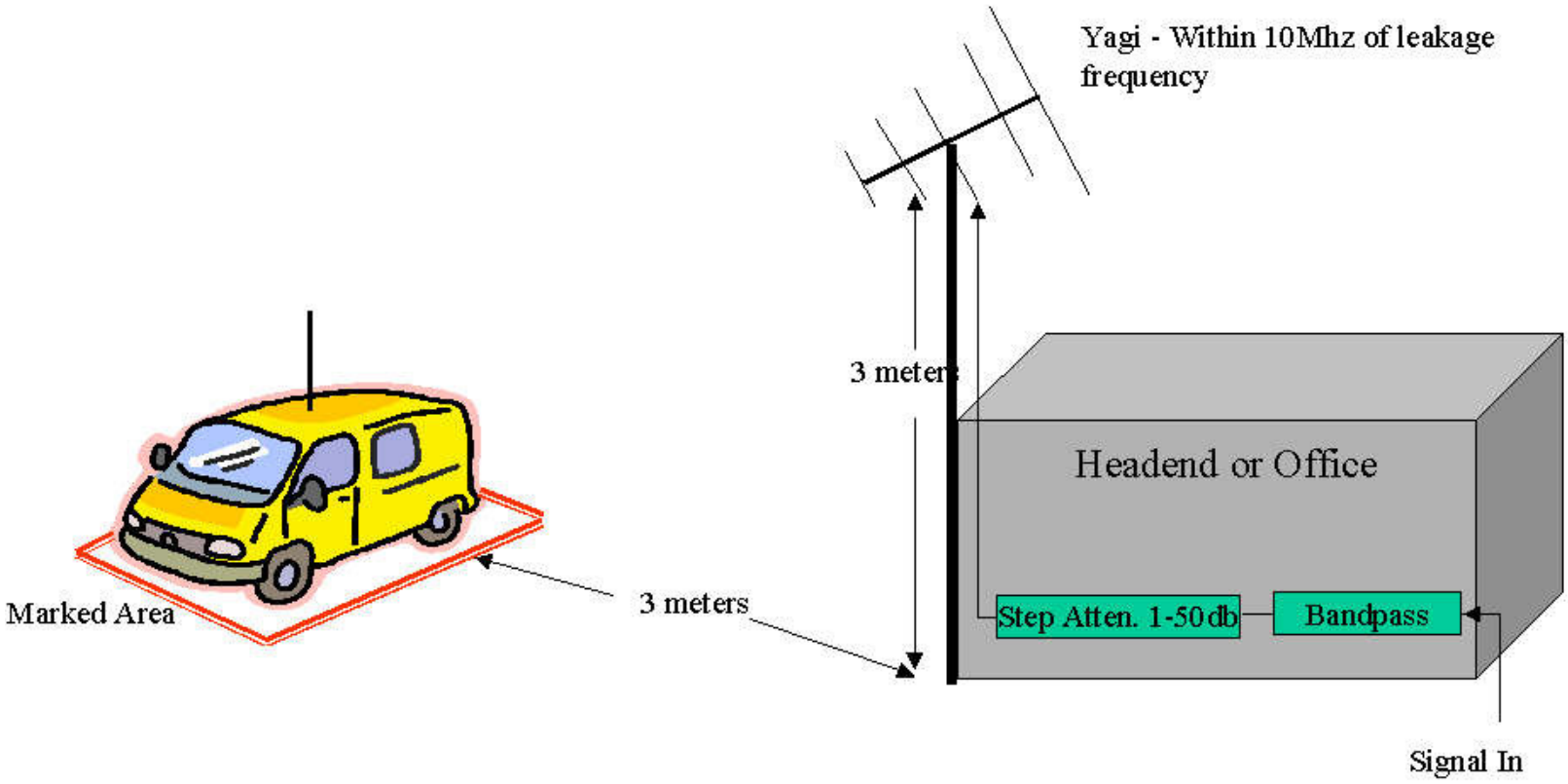
Patrolling for Leakage



Calibrating Leakage Detection Equipment.

1. Connect calibrated signal source set at 20uV/m.
2. Position the dipole antenna.
3. Adjust to read 20uV/m.

Drive-up Calibration Point.



Causes of Signal Leakage (1).

80% of all leakage is caused by problems between the tap and entry to the house.

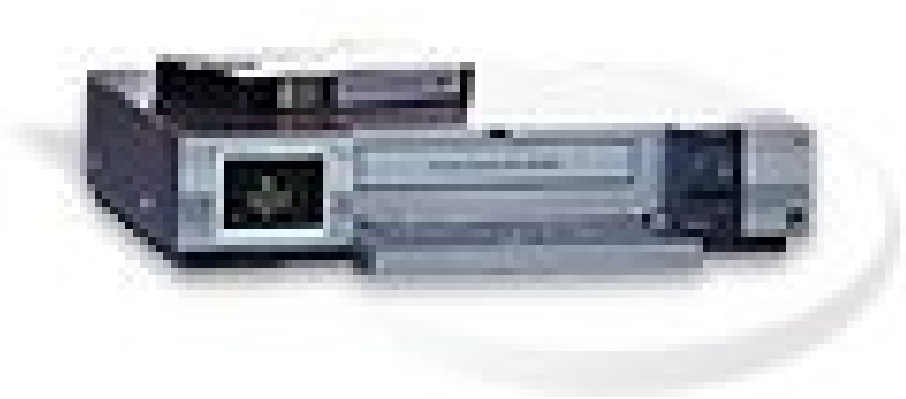
- **Aging and environmental stress.**
- **Physical trauma to cables or connectors.**
- **Loose drop connectors.**
- **Inferior quality coaxial cable, passives, or connectors.**
- **Loose hard line connectors.**

Causes of Signal Leakage (2).

- Improperly installed connectors.
- Cracks in the trunk and feeder cable.
- Animal chews.
- Poorly-shielded drop cable.
- Bad connectors at the tap.
- Corroded connectors.

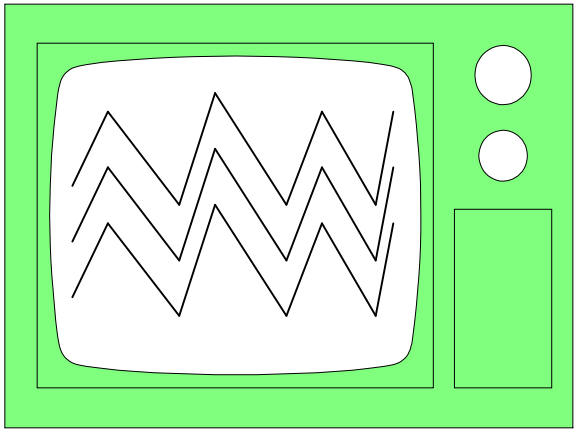
Causes of Signal Leakage (3).

- Customer installed equipment.
- Damaged amplifier housing or loose amplifier housing lid.
- Broken tap ports.
- Poor installation of splices and connectors.
- Poorly-shielded customer premise equipment.



Problems Caused by Ingress.

- Lines in pictures.
- Ghosting.
- Pay per view problems.
- High speed data problems.
- De-scrambling problems.



- Interference with two-way radio services using the same frequencies.

Problems Caused by Ingress in digital channels.

- Mosaic.
- Freeze frame.
- Picture and sound to black.

Type of Leakage Detecting Equipment.

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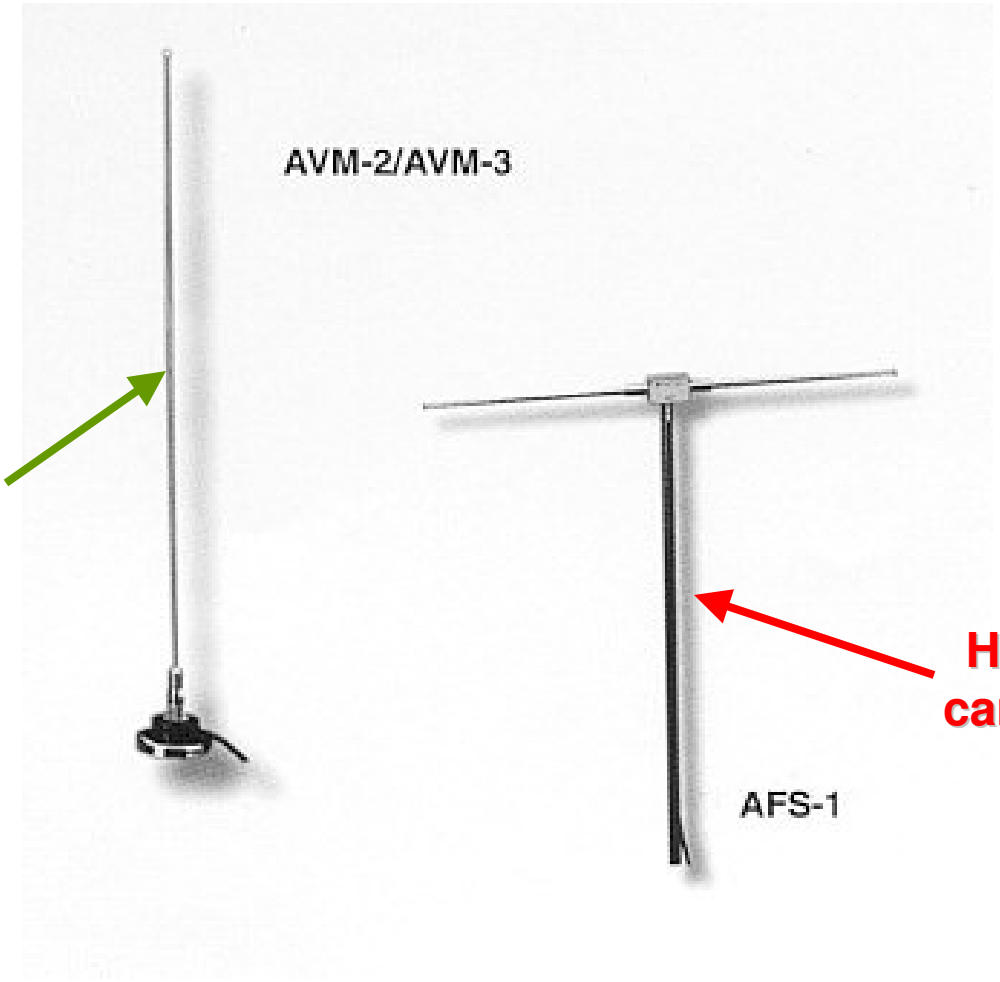
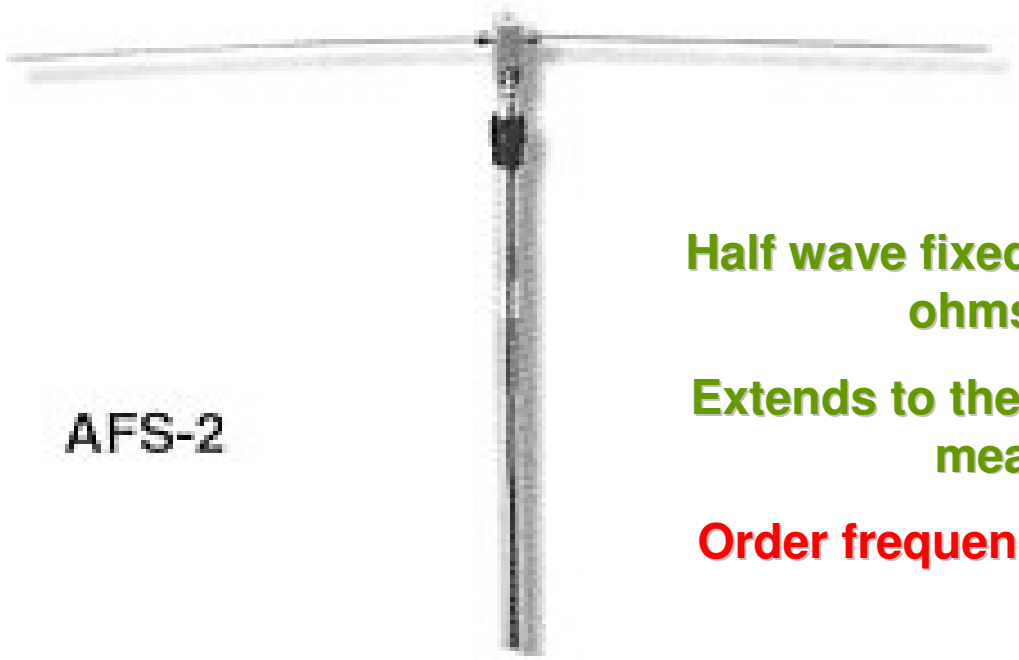
Accessories for the Super Plus.



Vehicular Antenna
AVM-2 108 to 118 MHz AVM-3 118 to 157 MHz

Half Wave Dipole can be extended to 20 feet

Accessories for the Super Plus.



Half wave fixed frequency dipole 50 ohms impedance.

Extends to the require 10 feet for CLI measurements.

Order frequency: 108 to 157.25 MHz.

Accessories for the Super Plus.

Near-field probe for close-in detection of signal leakage.

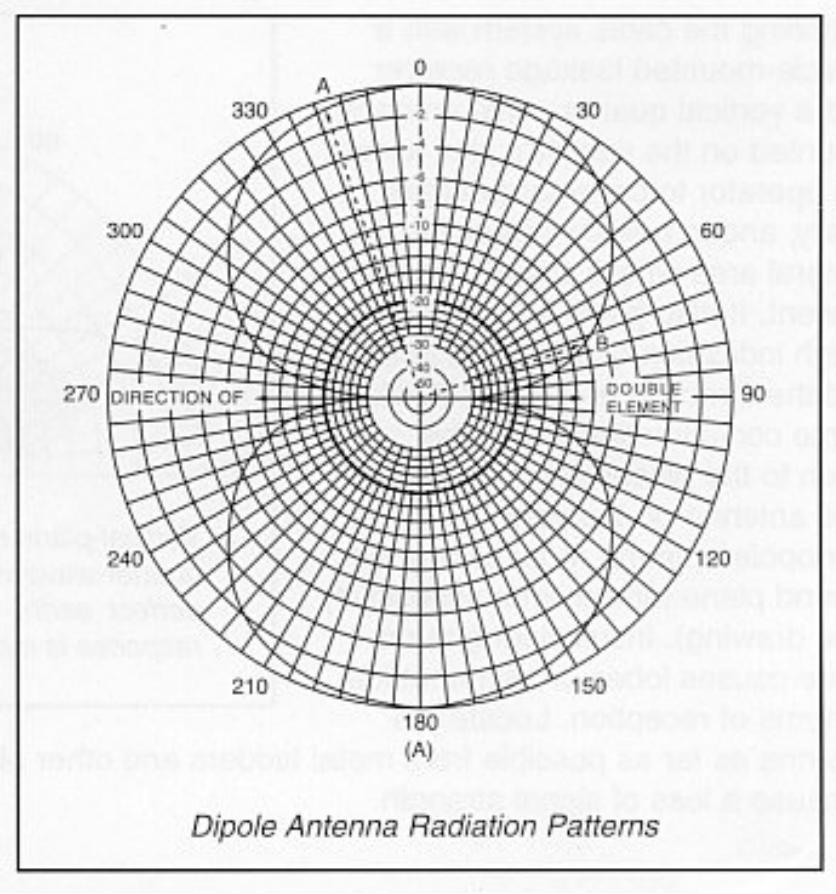
Accessories for the Super Plus.

The solution to "False Alarms"

Give low-frequency modulation, ignored by the TV sets, but causes a distinctive response to TRILITHIC Searcher Plus and Super Plus. When use it eliminates all "false alarm" triggers and increases leak detection sensitivity by four times over previous models.

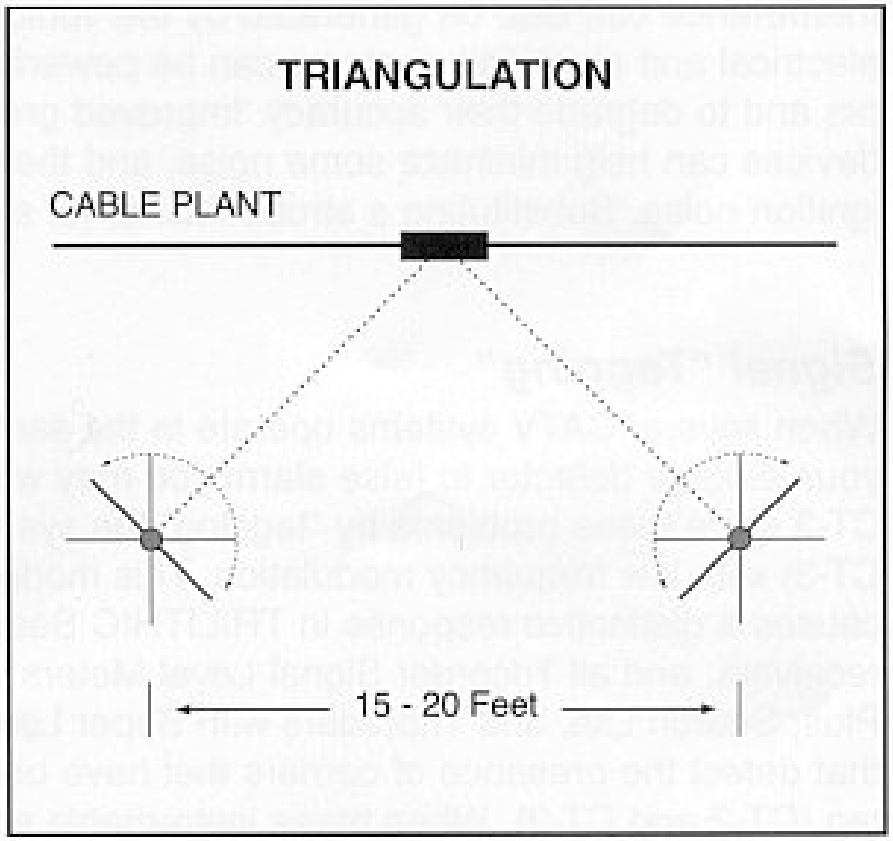
Dipole Antenna Radiation Patterns.

Pattern of the dipole antenna installed in the roof of the truck doing CLI testing.



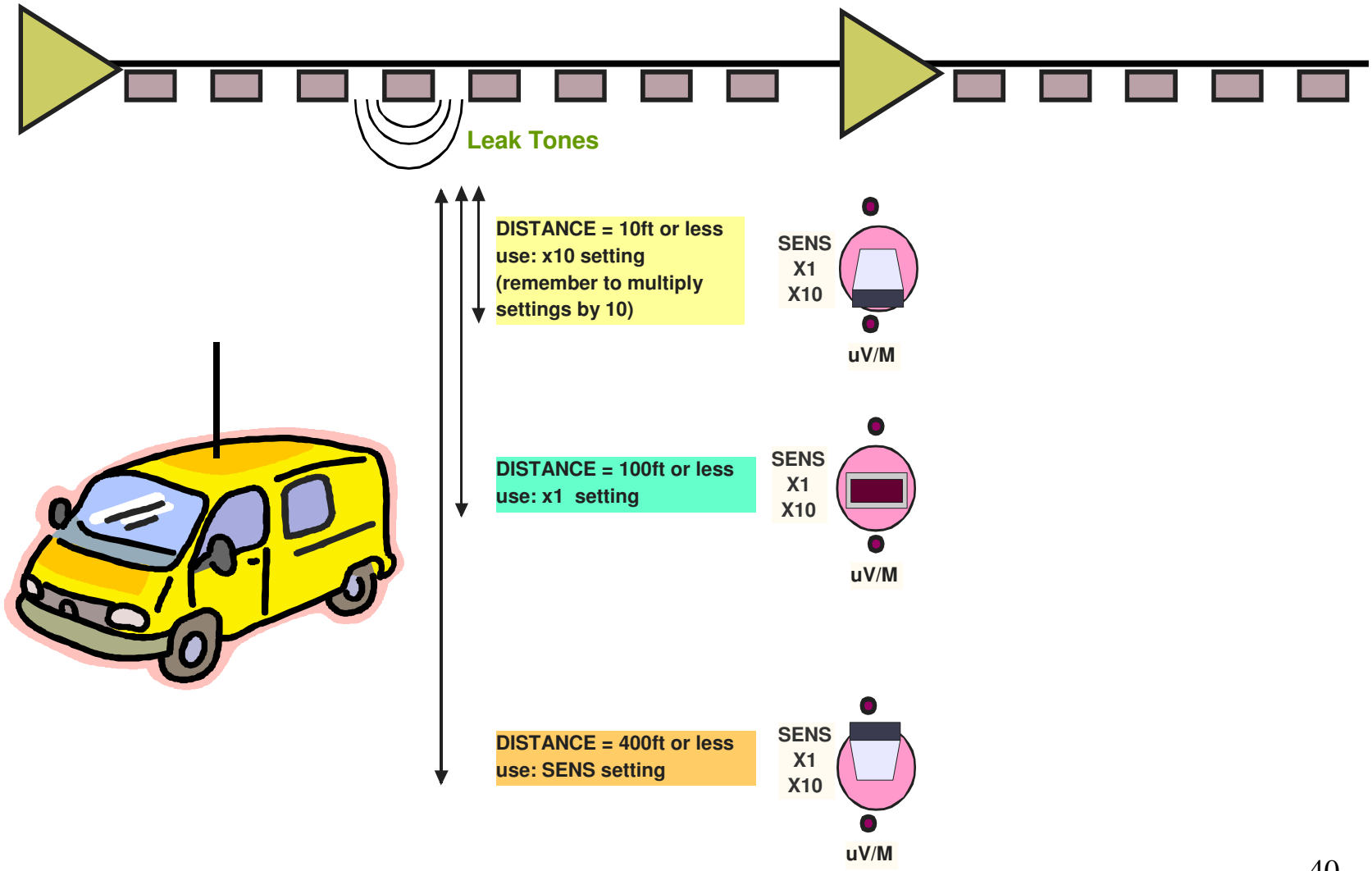
Dipole Antenna Radiation Patterns

Finding a leak for CLI.



Drawing represents 2 antennas being rotated to find peak readings on a meter.

Finding Leakage.



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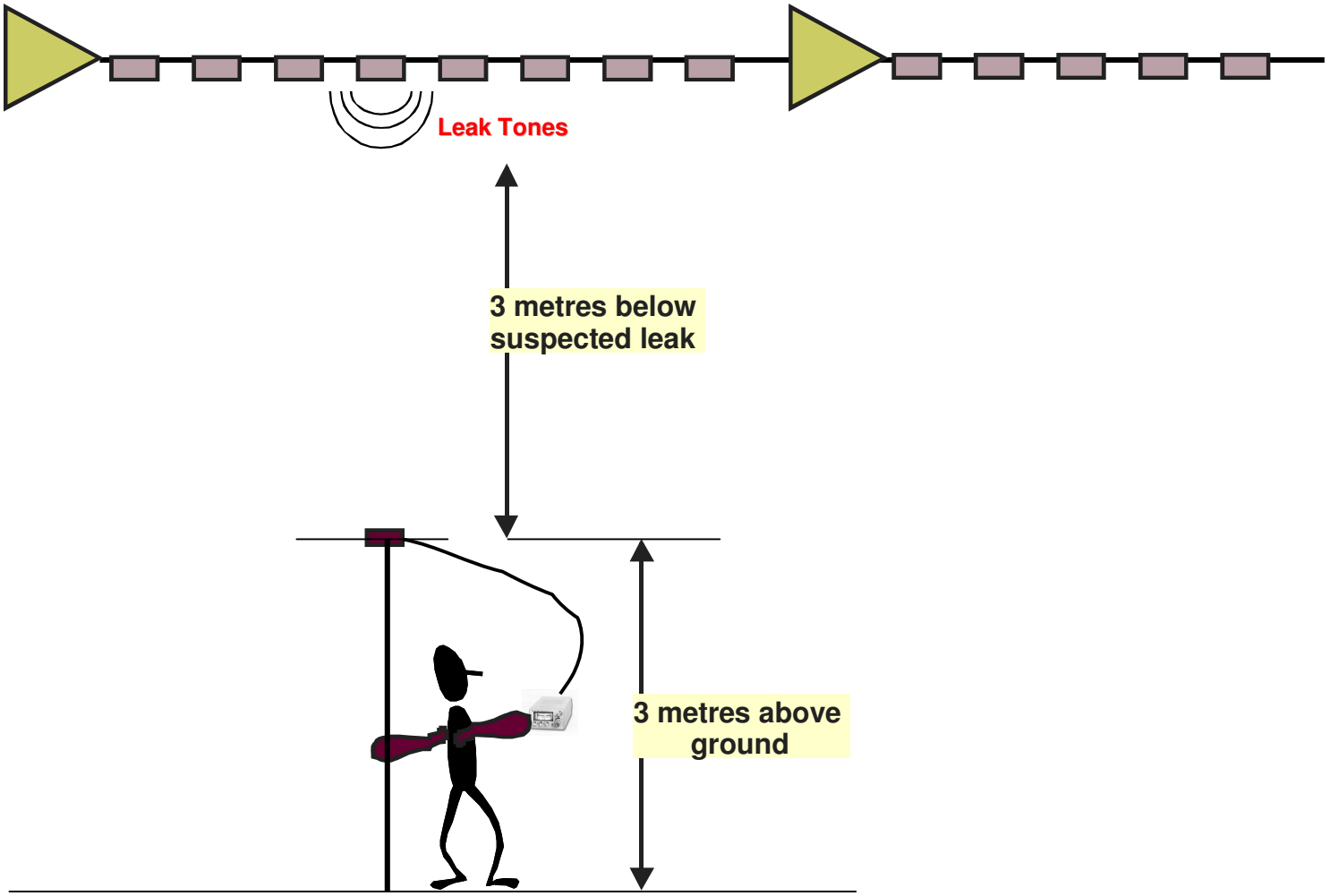
Leakage Measurement.



Interesting web sites.

Below are web sites where you can get technical information on CATV and HFC systems. Most of these sites are from University and are free.

http://cable.doit.wisc.edu/cable_resources.html

http://www.itcom.itd.umich.edu/cabling/fib-glos.html

http://whatis.techtarget.com/definitionsAlpha/0,289930,sid9,00.html

Interesting web sites.

Below are web sites of all the majors CATV and FIBER OPTIC and COAXIAL CABLES supplier.

http://www.acterna.com/

http://www.aflfiber.com/

http://www.alphatechnologies.com/

http://www.amcomm.com/

http://www.amphenol-catv.com/catvfamsearch1.cfm

http://www.c-cor.net/

http://www.commscope.com/html/home.shtml

http://www.corning.com/OpticalFiber/

http://www.electrolinequip.com/en/about_us/faq/index.html

http://www.corning.com/corninggilbert/

http://www.lindsayelec.com/lspa.html

Interesting web sites.

Below are web sites of all the majors CATV and FIBER OPTIC and COAXIAL CABLES supplier.

http://www.gi.com/

http://www.nettest.com/

http://www.ofsoptics.com/NASApp/cs/ContentServer?pagename=ofsoptics/templates/ofsopticsmain

http://www.powerware.ca/

http://www.ppc-online.com/main2.cfm

http://www.timesfiber.com/

http://www.trilithic.com/

http://www.visionteq.com/

http://www.wavecom.ca/

The end of this session.