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Selecting a Suitable Site for a Satellite Based Headend Facility

By

Michael J. Martin

When designing and building a new television signal collection facility or headend, satellite reception is commonly a core requirement to receive source signals. One of the first steps in designing such a facility is to review the proposed site(s) for their suitability to receive proper, clean, stable, interference-free reception of satellite signals. The following is a basic checklist of some of the issues that should be reviewed prior to selecting the final site for the new installation.

Since every site, every customer, and every application are different in some way from each other, there will likely be other technical, political, and economical considerations that may negatively impact on the new headend. Every effort should be taken by the customer to clearly identify these issues, in advance of the survey, in order for them to be considered and their impact weighted into the design.

The following points should be reviewed:

1. Does the site offer a clear and unobstructed view to the entire domestic satellite arc?

    1.1. The traditional domestic satellite arc is considered to include all satellites located in orbital slots from 69° W to 139° W for Canada and the United States.
    1.2. Actual bearings to the individual satellites will vary coast to coast, and on a north / south basis, satellite look angle tables should be generated for each site with, and without, local magnetic deviation calculated
    1.3. All official and technical discussions, as well as, all documentation should be based upon "true north" bearings only. Be very cautious to ensure this point, as significant design errors are possible, if its impact is not properly considered.

2. Are there any satellites desired that are outside of the boundaries of the traditional domestic satellite arc?

    2.1. Are there any transoceanic satellites required?
    2.2. Are there any special technical standards that need to be met, or exceeded, to receive any of the satellites being collected (examples of transmit standards include Intelsat E-1, D-1 and G standards, Eutelsat, FCC Paragraph 25.209, Industry Canada / Telesat Access Agreement standards, ITU-R, S.580-4 and S.465-5 recommendations for pattern performance [formerly CCIR] and for the receive only applications we consider the FSS two degree or DBS nine degree spacing rules, etc.)

3. Is there an inbound signal traffic plan?

    3.1. What satellites are desired?
    3.2. What channels or services are required?
    3.3. What frequencies are required from these satellites?
    3.4. Are steerable or fixed antennas required?
    3.5. Are the source signals analogue or digital?
    3.6. Are the source signals encrypted or scrambled?
    3.7. How stable are the desired satellites; end of life, inclined orbit, new?
    3.8. Are the desired satellites footprints providing suitable coverage to permit the reliable reception at the receive site?
    3.9. What is the EIRP of the desired transponders for the receive site?

4. Define the antenna(s) required

    4.1. What size antennas are required?
    4.2. What type of feed is desired; centre-fed, offset, Gregorian or cassegrain?
    4.3. What standard or quality expectation does the customer desire for these antennas?
        4.3.1. Spun or Hydroformed aluminum antennas
        4.3.2. Stamped antennas
        4.3.3. Fibreglass or compression molded
        4.3.4. Mesh or expanded metal antennas
    4.4. What type of feed is required?
        4.4.1. C-Band, Ku-Band, or a hybrid feed?
        4.4.2. Single, dual or four-port?
        4.4.3. Circular or linear polarization?
    4.5. What grades of LNBs are required?
        4.5.1. Analogue or digital
        4.5.2. High data rates over 1 Mbps (DRO) or low data rates less than 512 kbps (PLL) rate
        4.5.3. Does a PLL LNB need to be externally referenced with a 10 MHz locking source for extremely low data rates or unstable transmissions?

5. Define the foundation required

    5.1. Roof top versus ground
    5.2. What considerations are being made for freezing, underground water and the stability of the soils?
    5.3. If on a rooftop, how high is the building above grade?
    5.4. If on a rooftop, what kind of structure is the building - steel or concrete?
    5.5. What spacing is the roof top grid based upon (distance between centres)?

5.6. What is the mean bearing to the centre of the domestic arc?

6. Using satellite look angle tables, are there any physical obstructions that may impact year round reception

6.1. Terrain, buildings or structures, current or planned for the future,
6.1.1. Will blockage occur,
6.1.2. Will grazing occur,
6.1.3. Will the offending building be increased in size, or have or telecommunication structures or antennas added at a later date,
6.2. Rain Fades
6.2.1. What is the predicted annualized rain fade specification for the site?
6.2.2. What fade margin above threshold is required?
6.3. What performance reliability specification does the customer want for their systems;
6.3.1. 99.5% or consumer backyard dish grade,
6.3.2. 99.95% or CATV grade,
6.3.3. 99.99% or typical broadcast grade,
6.3.4. 99.995% or CBC or highest grade?

Total hours per year equals 8760, which is a total minutes per year of 525,600

Reliability (expressed as a % of a year)	Service Availability in Minutes per Year	Loss of Service Prediction per Year in Minutes	Loss of Service Prediction per Year in Hours	Grade
99.5%	522,972.0	2,628.0	43h 48m	Poor
99.95%	525,337.2	262.8	4h 23m	Good
99.99%	525,527.5	72.8	1h 13m	Very Good
99.995%	525,573.7	26.3	26m	Excellent

Notes:
a. / The performance reliability figures shown are for the satellite receive antennas only and do not consider any other downstream technology.
b. / The rain fades are typically spread out throughout the year, but increase during the rainy periods of the year, such as in the spring and fall.
c. / Rain fall characteristics vary in type, for example, Toronto has severe, intense summer downpours lasting usually less than 15 minutes in duration, whereas Vancouver has a slow, continuous drizzle sometimes lasting for days. The Toronto storm will knock you off the air, whereas the Vancouver rain will simply reduce your margin and create thermal noise, which will typically have little impact upon the service of a well-designed antenna system.
d. / Snow is transparent from an RF point of view. However, when it gathers inside the parabola of a satellite antenna, it can effectively change the optical path alignment of the antenna and cause service outages. Manual removal or an electrical de-icing solution is advisable in snowy areas, especially near ski resorts where sticky, artificial snow is synthetic.

6.4. Trees and foliage

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6.4.1. Foliage may be worse in the spring and summer when the leaves are loaded with moisture,
6.4.2. Or, grow in the short term to medium term to cause blockage,
6.4.3. Does the customer have the rights to either remove the trees or top them as required; are they on a neighbour's property?

6.5. Remember to make use of the correction factors for the local magnetic deviation for the site must be considered in planning the look angles.
6.6. Should a professional look angle test be conducted for the full arc using a portable test antenna and a spectrum analyzer and plotter?
6.7. Remember to consider both dimensions for azimuth and elevation.
6.8. What is the plan to deal with the annual spring and fall solar outages?

7. Does the site have any Terrestrial Interfere (TI) problems?

7.1. Should a TI site survey be conducted?
7.2. Is all the local 4 GHz microwave shut down in the area as has traditionally been used by the local common carriers, such as the telephone companies,
7.3. Is the site close or on the glide path for an airport or heli-pad that may be a source for radio altimeter interference from aircraft?
7.4. Is the site in an area where Doppler radar can impact it commonly used in port areas, cruise ships, military vessels, weather tracking, etc?
7.5. High energy DC will cause interference in some C-Band digital source signals, so will snow mobiles, vehicles, riding lawnmowers, HVAC equipment, trash compactors, cranes and lifting devices, etc. be in the line of sight and potentially cause TI interference.
7.6. Will TI filters be required for the C-Band source signals?

8. Power (mains) lines and other low frequency lines attached to towers and telephone poles are typically not a major concern unless they are blocking the line of sight. However, please realize that such signals might be a source for low frequency ingress interference that leaks into poorly grounded or shielded cables and equipment

8.1. High tension AC power lines will likely cause interference with off-air signal sources in the low channel VHF frequencies between channels 2 to 6 (54 MHz to 88 MHz), to a lessor extend to channels 7 to 13 (174 MHz to 216 MHz) and, likely not at all, to UHF channels 14 to 83 (470 MHz to 890 MHz).

9. Is there sufficient space available for the antenna farm?

9.1. A typical 4.5 metre antenna may require a footprint of approximately 25 feet by 25 feet,
9.2. Is there room to layout the antennas in a straight line, in a box pattern, a trapezoid pattern or on a varying elevation arrangement like in a "bleacher" or tiered pattern?
9.3. Is there room for future expansion of the antenna farm?

9.4. The distance between antennas may need to be between a minimum of 20 to 30 feet depending on the satellite traffic required, the site's location and the size of the antennas being installed.
9.5. Is there room for suitable security fences to be installed and for the satellite antennas to see over them without obstruction? Note: CSA requires fences to be placed around all steerable antennas on the ground. Rooftop consideration is also required for fencing.
9.6. Is there view clearance over roadways and trucks (13' 6")?
9.7. Is there anything else buried at or near the installation site? What about water mains, sewage conduits, waste, hazardous materials, telephone lines, and electrical cables?

10. Cable Interfacility Links (IFLs)

10.1. How long will the cable runs be?
10.2. Are the cable runs a direct route or are there many bends?
10.3. What type of cable or optical fibre is required?
10.4. How many IFLs are required?
10.5. How many spare IFLs are planned?
10.6. How will the cables be managed? Will they be buried, in conduit, in cable tray, or mounted from messenger wires?
10.7. How will the cables enter the building?
10.8. What bending radius is required for the cable type planned?
10.9. If the cables are to be buried, will there be any need to tunnel under walkways, driveways or roads?
10.10. Is there anything else buried at, or near, the installation site? What about water mains, sewage conduits, waste, hazardous materials, telephone lines, and electrical cables?
10.11. How will the DC power required for the LNBs be delivered to the antennas?

11. Grounding. How can suitable grounding be achieved?

11.1. Lightning grounds
11.1.1. Will lightning surge arresters be required?
11.1.2. Will lightning rods be used?
11.1.3. Is there a roof top lightning ground system in place?
11.2. Building and structural grounds
11.2.1. Is there a ground strap on the rooftop for the building ground?
11.2.2. How will the grounds and bonds be made? Cadweld? Clamps?
11.3. Technical or isolated grounds
11.3.1. Will ground blocks be required to isolate the building ground from the technical ground?
11.4. Which grounding strategy will be utilized? Ring, star, or bus?
11.5. How many final ground points will there be? One? Or more?

12. AC power

12.1. Is there suitable AC power available to the site?
12.2. Is it clean and free of defects? Surge, brownouts, spikes, harmonics, etc.?
12.3. Is the neutral clean of reflected power (switching power supplies, etc.)?
12.4. Will an Uninterruptable Power Supply (UPS) solution be installed?
12.5. What system elements will be backed up on this UPS?
12.6. What power requirements need to be considered for the satellite antenna farm?
12.6.1. Technical service power? Typically 110 VAC / 60 Hz / Single Phase.
12.6.2. Is there power to drive the motors on a steerable antenna? Typically 208 VAC / 60 Hz / 3-phase.
12.6.3. Is there power for electrical antenna de-ice systems? Typically 208 VAC / 60 Hz / 3-phase and 110 VAC / 60 Hz / Single Phase.
12.6.4. Is there sufficient amperage for the above requirements for the current antenna farm and any future growth?

13. Cable entry into the building

13.1. How many cables are entering the building?
13.2. Is the entry secure and weather proof?
13.3. What kind of cable entry solution is being planned?
13.4. How much space is required for this cable entry?
13.5. What structural reinforcement is required, if any, to support this cable entry?

14. Structural loading

14.1. What structural loading will be imposed on the soils or the rooftop?
14.2. Can the soils or the rooftop manage these loads?
14.3. If a rooftop, how old is it and when will it need to be replaced?
14.4. Are there any window washer anchors to consider (relocation) on a rooftop?
14.5. What special reinforcement is required for the columns that will propagate the loads?
14.5.1. Column reinforcement
14.5.2. K-bracing
14.5.3. Is a crib required on the roof?
14.6. Are all loads and moments being properly considered with a suitable safety factor?
14.7. What is the safety factor for the loads?
14.8. What wind speeds are being used for the calculation? CSA directs us to use 125 miles per hour or 201 kilometres per hour. Some customers direct us to make use of lower maximum winds speeds. However, any change from the CSA standard is solely at the customers risk.
14.9. Is there a location to position a crane to lift the materials to the rooftop?

14.10. If on the ground, can we still make use of a crane or a HIAB articulated crane, so they will not sink into the soils causing injury, damage or expense?

15. Soils

15.1. If the installation is to be built on the ground (very desirable), then is there a current and reliable geotechnical survey readily available?
15.2. What kinds of soils are present?
15.3. Which foundation design is likely to be used - mass, pier, rock or combination or these approaches?
15.4. How much moisture is likely?
15.5. How deep does the local frost levels penetrate annually?

16. What frequency bands are desired at the site?

16.1. VHF / UHF for off-air signals
16.2. L-Band
16.3. C-Band
16.4. Ku-Band
16.5. Ku-DBS Band
16.6. Ka-Band

17. Will a tower structure be required to mount off-air antennas?

17.1. How tall will this tower be?
17.2. Is there suitable line of sight to the local over the air TV transmitters?
17.3. Will the off-air signals be impacted by reflections or multi-path from buildings and / or the terrain?
17.4. How far away are the transmitter towers for the desired off-air signal sources?
17.5. What are the channels / frequencies for the off-air signal sources?

18. Satellite antenna equipment rack room (Central Equipment Room or CER)

18.1. How much space is available for the equipment racks with required clearance for technical access, maintenance, and building codes?
18.2. How far is the CER from the antennas?
18.3. How high is the ceiling? Can we stand up a rack (corner to corner)?
18.4. What is the door access to the room like?
18.5. How will the cables be run? Overhead in trays or under a computer floor?
18.6. Will the racks be mounted on a plinth?
18.7. Will two 15-amp breakers be wired to each rack?
18.8. How is the heating and cooling being managed for the CER?

18.9. Is there a truck level loading dock? Can a long haul transport rig back into the loading dock?
18.10. Is there a tow motor or pump truck available?
18.11. Is there inside storage available? How much?

19. To what fire code standards is the wiring to be design?
19.1. Can FT-4 cable be used to wire racks found in the same room?
19.2. Does FT-6 cable or FT-4 cable inside a conduit required for inter-room or plenum cable runs?

The following is a sample of a few of the cable fire codes and how they relate to each other. There are more designations available then what is shown; these are considered the most relevant codes to the communications industry.

C (UL) Harmonized Code for both Canada and USA	CSA C22.2 No 214 / UL444 Section 60 for the Canadian Electrical Code, Part 1 (CEC)	Application	USA NEC 800 Use
CMH	FT-1	Drop Cable	Residential
CMG	FT-4	Same Room	Commercial
CMP	FT-6	Inter-Room	Plenum / Riser

Important Note: Although the codes shown above covers wire and cable installed in factories, office buildings, hotels, motels, apartment buildings, residences, and all cables which pass through any floor, wall, ceiling, or travel in ducts, plenums, and other air handling spaces, each individual municipality, city, county, or province can decide whether or not they wish to adopt to these standards as law. Local authorities having jurisdiction enforce their own codes. They have the right to accept or refuse any installation in accordance with their local laws. One of the organizations that local inspectors rely on to test wire and cable is Underwriters Laboratories (UL) and another is the Canadian Standards Association (CSA). The C (UL) designation is indicating a common and harmonized standard accepted in both Canada and the United States. Be sure not to confuse this C (UL) designation with another designation referred to as ULc, which is different. The National Electrical Code (NEC) is a United States based authority with no real value in Canada. The NEC codes are shown for cross-reference purposes only.

20. Permits, Licenses and Authorities

    20.1. Is a building construction permit required or will it be tied into the construction permit for the building leasehold improvements?
    20.2. What local ordinances should we be concern about?
    20.3. What zoning laws, easement restrictions, side yard and setback clearances are required?

21. Does the customer have the proper licenses from Industry Canada and the CRTC to operate their new facility or business?

    21.1. What licenses are required?
    21.2. What levels of government have jurisdiction?

22. Is there proper documentation available for the site?

    22.1. A site plan.
    22.2. Structural drawings.
    22.3. Complete architectural drawing set?
    22.4. Soils reports.
    22.5. Is the original architect or structural engineer still available and with relevant, current knowledge of the site and its structures?

Note: This document is offered as a guide only and does not consider every single issue or site-specific points of design that may be critical for a successful installation. All customers are well advised to secure the professional services of a qualified satellite systems integrator, such as MICAN Communications, to help them to further define their specific RF and site requirements

Remember the "7-P rule"

Proper Prior Planning Prevents Pitifully Poor Performance

MICAN Communications Inc.
16 Canmore Boulevard ♦ Toronto ♦ Ontario ♦ Canada ♦ M1C 3W1
416-287-3400 Telephone ♦ 416-287-9400 Facsimile ♦ 416-729-9991 Cellular
michael.martin@mican.ca Email ♦ www.mican.ca Web Site