April 25, 2008

Bob Greenlaw
Director
Blaine County Emergency Communications
Hailey, ID 83333

Ref: Explanation of cellular vs. two-radio RF engineering

Dear Mr. Greenlaw,

This is in follow-up to our meeting with Deborah Vignes and Michael McNees on Friday April 18 at the Blaine County Courthouse.

For review the work I completed for you early this year regarding the new public safety radio communications tower was to suggest an antenna RF engineering design that would work given your technical up front restrictions as follows and meet your radio communications requirements.

- Antenna support structure MUST be a monopole.
- Antenna support structure height cannot exceed 75', the FAA maximum approved height.

In the meeting and in subsequent discussions I was asked to explain the differences between cellular radio engineering and two-way radio engineering. The following attempts to address this in layman's terms.

In general two-way radio systems operate on a fixed set of FCC licensed frequencies that are designed to operate over a large area, sometimes 50 to 100 miles. These types of systems are not dependent upon frequency reuse in a small geographical area so they are routinely installed at high mountain top or high tower locations to provide maximum area coverage. The critical issue with these systems is that there is good signal path and signal level between the repeater or mountain top infrastructure and the mobiles, portables, and base stations which in general must have line-of-sight between them for optimum performance. Non line-of-sight operation is severely degraded utilizing portables inside buildings so the better infrastructure location line-of-sight to the building, to use this example, the better the portables will operate in this environment.

Wireless Site Solution LLC
903 Caldwell Blvd., #218
Nampa, Idaho 83651
208.461.5075 Office
208.250.4770 Mobile
chuck.robertson@wssllc.us.com

While the same radio path clearance requirements are the same for cellular radio and two-way radio systems, there are multiple sites in a cellular system and they are designed with frequency reuse in mind. Since there is a finite amount of radio spectrum that all radio frequency services must share, a way had to be found to use the same frequencies over and over again in a given area so that enough frequencies or channels would meet the capacity requirements of the subscriber base. The net result of this was shorter antenna support structures (less than 300 feet usually) in initial design with current technology design using very short structures of 100 feet or less depending upon channel capacity requirements, frequency band used, and the terrain/landscape that has to be covered.

In cellular systems as channel capacity requirements increase, cells are split into smaller cells and frequencies are reused again. This does NOT occur in two-way radio system design as you know because your public safety systems are on the same sites they have been on for years with channel capacity increase accomplished by adding another FCC licensed repeater channel pair at the same sites.

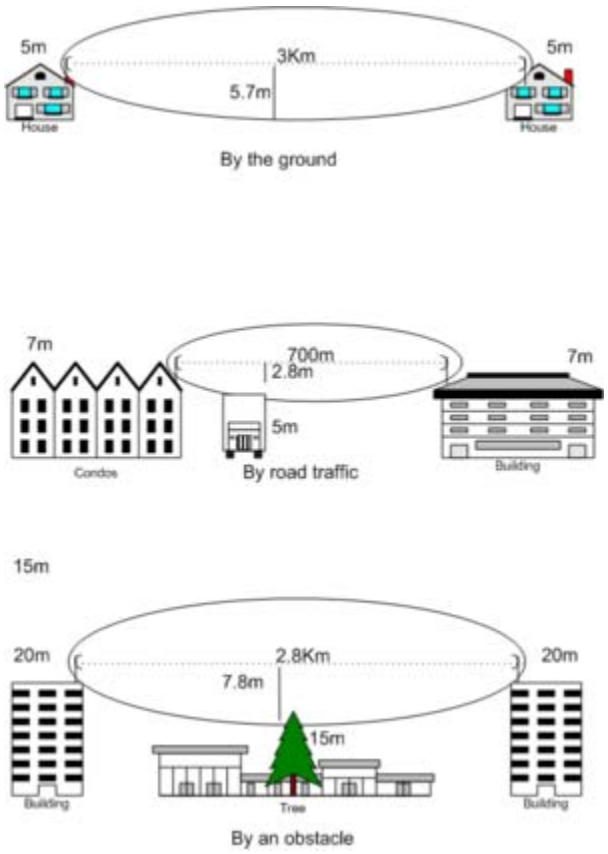
It is important to note that there is no changing the laws of physics. A radio frequency signal from a cellular tower or two-way radio tower MUST be able to get its signal from the transmitter to the receiver AND from the subscriber unit or two-way radio back to the transmitting and receiving facility (repeater or cell phone tower). If this cannot be done for whatever reason, antenna structure not high enough, too much distance between a transmitter and a receiver, and path obstructions or what is called land clutter (buildings, vegetation, and other surface features), the result is a radio frequency connection that does not work.

There are (4) factors driving the height requirement of antenna structure at the new Justice Center.

Factor 1: Microwave surface terrain landscape clearance toward Picabo Mountain which is required for the 700MHz two-way radio system, which requires the 6GHz microwave link to operate point-to-point, **line-of-sight**, with Fresnel zone clearance (nearby close-in path obstructions).

Microwave will not work with path obstructions. See diagram on next page.

Wireless Site Solution LLC
903 Caldwell Blvd., #218
Nampa, Idaho 83651
208.461.5075 Office
208.250.4770 Mobile
chuck.robertson@wssllc.us.com



Factor 2: Sufficient vertical space to physically mount all required antennas. Note that the total number of antennas has been greatly reduced in the design due to use of radio system combiners. Refer to the Blaine County Emergency Radio Communications Tower study from 180 Connect Network Services dated January 2008.

Factor 3: Sufficient vertical space and vertical separation between all required antennas to ensure they do not mechanically or electrically interfere with each other. Details of this are also in the study.

Factor 4: The ability to communicate directly from the new Justice Center to units in the field without the infrastructure (repeaters or microwave links) operational. The lower the antenna height the shorter the direct radio-to-radio range will be.

I've been asked if there is any other way to accomplish consolidated radio communications capabilities such as mount antennas low on a parapet wall edge surrounding the building or possibly use multiple poles less than 40 feet for all required antennas.

Wireless Site Solution LLC
903 Caldwell Blvd., #218
Nampa, Idaho 83651
208.461.5075 Office
208.250.4770 Mobile
chuck.robertson@wssllc.us.com

I recommend the design as outlined in the radio tower study. This would be the cleanest and least obtrusive structure and RF design that would meet two of Blaine County's objectives (monopole and reduced antenna structure height), albeit higher than 40 feet. This design will accomplish your consolidated radio dispatch objectives in a professional manner even with the aforementioned limitations.

Other installation scenarios would be messy, add additional costs, and provide additional technical challenges such as how to overcome the lack of vertical separation required for the proposed radio system combining design which already increases system signal losses in order to minimize the total number of antennas as detailed in the study. I would not consider these types of scenarios a system design but rather antennas being installed in a haphazard manner with predictable troublesome results.

Possibly the best way to summarize simply the difference between cellular RF design and two-way radio RF design is that cellular antenna support structures are generally designed to capture the signals of hand held devices over a small geographic area (cell) and two-way radio systems are generally designed with higher sites (mountain tops) much farther away from the devices they need to capture a signal from, requiring RF design (including antenna height) that maximizes infrastructure (repeater) to base, mobile, and hand-held unit for optimum performance.

Please let me know if I can help answer any additional questions.

Regards,

Chuck

Chuck Robertson
RF Project Engineer
Wireless Site Solutions LLC

Wireless Site Solution LLC
903 Caldwell Blvd., #218
Nampa, Idaho 83651
208.461.5075 Office
208.250.4770 Mobile
chuck.robertson@wssllc.us.com