



Increasing Data Transfer Rates can Decrease Reliability

The Laws of Physics are Key to Selecting a Wireless Data Solution

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Nearly everyone who deploys any kind of radio frequency (RF) data system opts for the solution with the highest performance rate. The problem is that any time you increase performance, reliability will be affected negatively. A key factor in successful RF deployments is understanding the intricate relationship between channel modulation and channel width to get the most out of your RF system.

“Performance” is typically measured by the amount of data that a link can successfully transmit from point A to point B. “Reliability” is determined by the strength of the RF signal AND its separation from the background radio noise.

The first criteria for having a strong RF signal is that it must be above the minimum sensitivity thresholds of the receiver equipment at any given channel and modulation setting. This is very important for planning any RF deployment, as the impact of changing channel sizes and modulation schemes directly changes the receiver sensitivity.

Here are the key things to remember when changing settings for increased performance:

1. Doubling the channel size will result in a 3dB drop in receiver sensitivity. For example, if your radio system has -83dB receiver sensitivity at a 5 MHz wide channel, changing the channel width to 10 MHz means that the receiver sensitivity is now -80dB. Since this occurs on both ends of the link, the real world implication is that your reliability factor will suffer, unless the loss in sensitivity is made up for elsewhere in the system such as higher output power, higher gain antennas or shortening the link.
2. Moving from one modulation setting to the next higher setting also incurs the same 3dB penalty in receiver sensitivity and, of course, would require the same change to the system to maintain reliability.



Essentially, when you change either of these two settings, you inevitably affect the data rate, as well. Channel size is directly proportional to data rate. If you double your channel size while maintaining a given modulation, the result will be a doubling of data rate. Modulation, on the other hand, is not directly proportional and, in fact, moving higher in modulation gives you diminished return on performance.

The chart below illustrates this phenomenon.

Channel Bandwidth (MHz)								
Modulation	Narrowband Channels						Wide Band Channels	
Modulation	7	10	14	20	28	30	56	60
BPSK	13	19	26	37	52	56	104	111
QPSK	19	27	38	54	76	81	152	163
QAM16	25	36	50	71	100	107	200	214
QAM32	32	46	64	91	128	137	256	274
QAM64	38	54	76	109	152	163	304	326
QAM128	44	63	88	126	176	189	352	377

Assume a 10 MHz channel operating at BPSK modulation. If you want to double the data rate using only modulation, you would have to step from BPSK up to QAM16. Since the modulation is moved two orders higher, you will experience a 6dB drop in receiver sensitivity. You can get the same increase in data rate by changing your channel width to 20 MHz and leaving the system at BPSK. Since you doubled your channel width, you would only experience a 3dB decrease in receiver sensitivity.

In other words, you achieve the same result at only half the receiver sensitivity penalty. Higher order modulations also frequently require the Tx power to be turned down. So you may not only face the lower receiver sensitivity, but you would have to deal with the effects of lower signal strength, as well.

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