IMPROVING THE SAFETY AND EFFECTIVENESS OF TETRA RADIO USERS THROUGH INCREASED RADIO SENSITIVITY AND POWER

MOTOROLA

"2dB OR NOT 2dB, THAT IS THE QUESTION"*

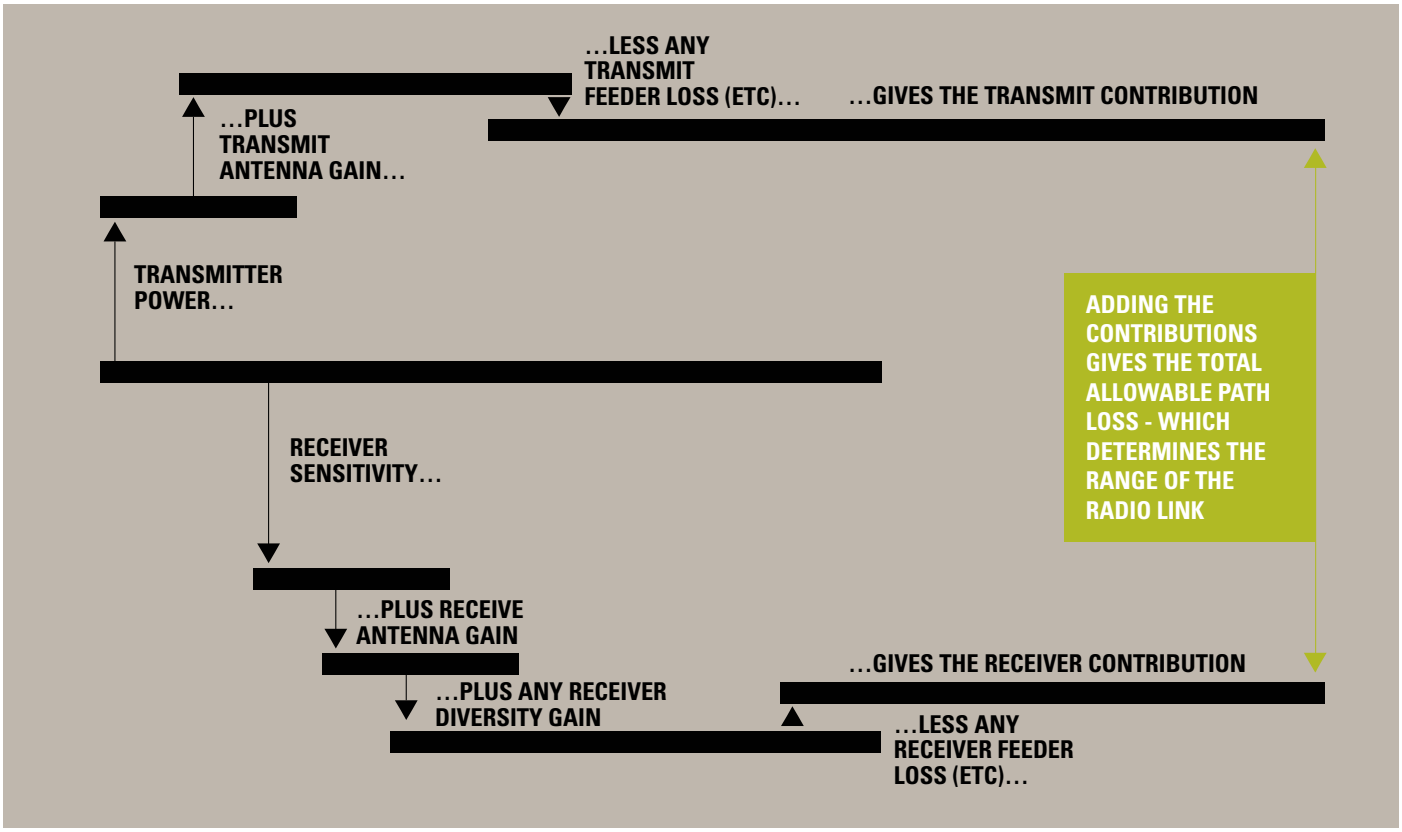
***HAMLET'S GUIDE TO RADIO PLANNING**

INTRODUCTION

Ensuring that end users are connected at all times is a critical feature of TETRA technology. The safety and effectiveness of officers, or operatives, is often directly linked to their constant communications. In fact, some officers have told us that the radio is more important than a side arm gun. TETRA networks are therefore designed for maximum coverage, both outside and in buildings.

Any improvement in radio sensitivity and output power will bring direct benefits to the users, improving connectivity both in marginal areas of coverage and indoors. Motorola is bringing an additional 2dB of receiver sensitivity in the MTM5000 and MTP3000 series radios, compared to similar terminals. In addition the MTM5400 and MTM5500 radios are equipped with 10W transmit power. These capabilities will deliver improved safety and operational benefits for operatives in the field.

Motorola's next generation subscribers, starting with MTM5000 series, and now the MTP3000 series radios, have a guaranteed receiver specification that are 2dB better than the TETRA specification and 'typical' specifications which are better in turn than this. This offers a genuine advantage over competitive products: this paper sets out the reasons.



RADIO BASICS

Radio planning is based on link budgets. Link budgets are the sum of transmit power, transmit and receive antenna gains and receiver sensitivity, less any losses such as coaxial cable feeder connections, and plus any gains such as base station receiver diversity. The resulting figure is the amount of path loss that the system can manage, or how much of the signal is lost between the transmitter and the receiver. This in turn determines the range.

In Direct Mode operation (DMO), the effect is easy to see. If transmit power or receiver sensitivity are improved, the system (in this case, any two radios communicating directly with each other) can cope with a greater path loss, and so range is improved.

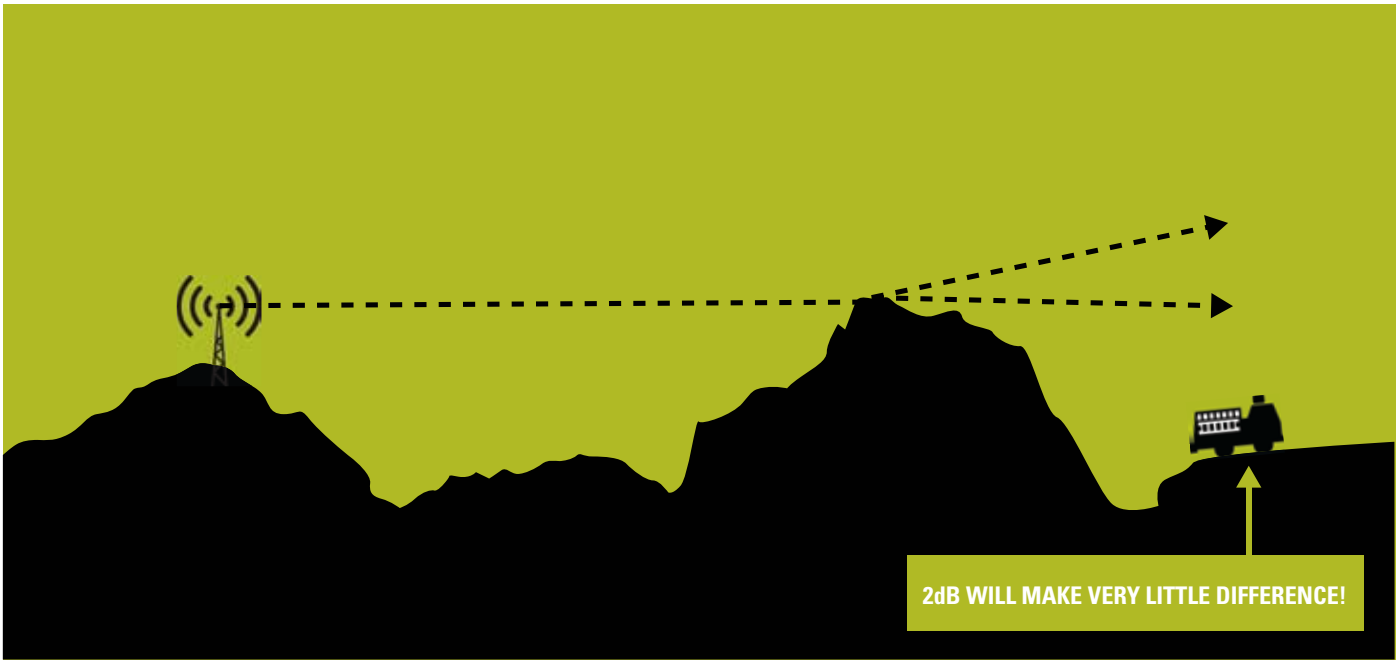
In Trunked Mode operation (TMO), the effect may not be so apparent as there are two path losses to consider – the uplink (mobile to base station) and the downlink (base station to mobile). Whichever link can cope with the smaller path loss will determine the maximum range from a system. If a system is uplink limited (i.e. the base station doesn't hear the mobile as well as the mobile hears the base station) then improved subscriber sensitivity does not affect the planned range from a site. However, if the system is downlink limited which can be the case when a base station has very good receiver sensitivity (like Motorola's MTS portfolio), where the receiver has 3 antenna diversity (like the MTS), and/or when the transmit power is limited (for example to minimise interference) then the subscriber sensitivity does have a direct bearing on range. In addition, if the improved sensitivity is linked to increased transmit power then the link will work better in both directions and the benefit of the increased sensitivity is matched and the TMO link is balanced.

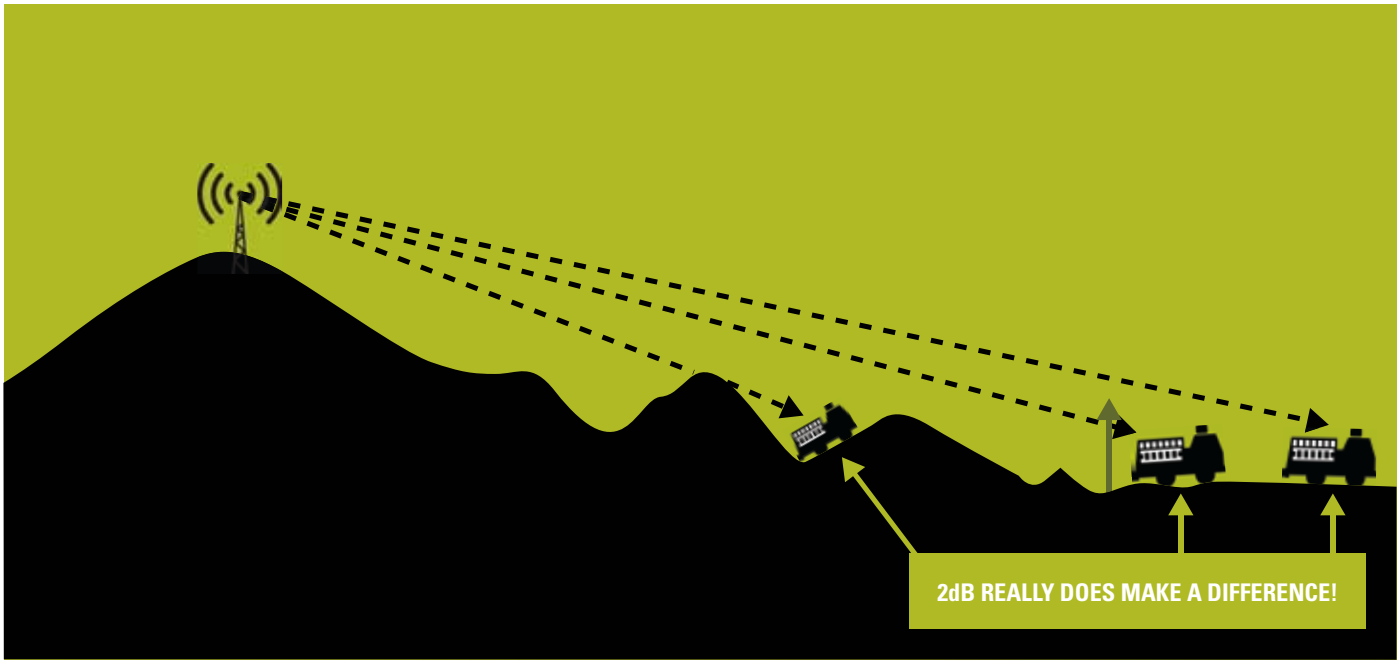
However, that is not the whole story. Even if the subscriber sensitivity does not improve the range in TMO it can improve the quality of the signal – and so the quality of the experience that the user obtains. For example, if a portable radio was reaching the limits of its range on a cell, a 2dB improvement in receiver sensitivity reduces signalling message errors by about 30%[1] – translating to fewer missed call set ups and fewer missed SDS messages. A similar improvement will be experienced in speech quality as there will be fewer distorted syllables and misheard words. In an uplink limited system, extra radio sensitivity will enable you to hear the commands such as 'evacuate the building' – you just will not be able to communicate back until you are back in coverage.

[1] Using the graphs in the TETRA Designers Guide, ETR300-2.

WHAT RANGE DIFFERENCE CAN 2dB MAKE?

In a real system, range and coverage areas are predicted by planning tools (such as Motorola's Combo or Hydra tools) using the real geography of the coverage area. They are usually backed up with measurements. In real terrain, if the range is determined by the signal running into a mountain, adding 2dB to the signal will make little difference! However in more normal uneven terrain, the extra sensitivity can reduce the number of 'holes' in coverage (as the signal becomes usable), and/or adds more coverage at the edge of range.





Range in 'typical' systems can be estimated using path loss equations derived by Hata and Okumura propagation model, which was formed as a result of measurements over real terrain in Japan and is used for predicting the behaviour of cellular transmissions. These empirically derived equations are universally accepted as a means to estimate system range. If the Hata suburban or urban models are used, a 2dB reduction in path loss provides a range increase of 14%, or a cell area increase of 30%. In a real system, the planning tool output will give a much better idea of actual improvements (see the previous paragraph) – but this certainly gives an idea of what can be achieved.

HOW WILL THIS COMPARE WITH OTHER TETRA RADIOS?

No other radios currently on the market have a similar guaranteed specification. Some may quote similar typical specifications – but a typical specification means that a radio will probably meet the figure quoted most of the time, in most conditions – but not all of the time in all conditions. For example, most radio performance often falls towards the edge of a frequency band. If the specification is guaranteed, it will still hold the specifications at the band edges. If the specification is typical then this will probably not be the case – which is unfortunate if your frequency assignment is close to these band edges. Therefore a guaranteed specification really does make a difference – it allows radio systems to be planned with confidence and for the users to really benefit from that extra performance. Please don't forget that the typical performance of the next generation radios is even better than the guaranteed specification, and so the user experience will be even better most of the time.

MOTOROLA RADIOS SUPPORT THE 2dB RECEIVE SENSITIVITY IMPROVEMENT.

The MTM5000 and MTP3000 series of TETRA Mobile and Portable radios have increased sensitivity which will provide the benefits described in this paper. Users will experience improved range and in-building coverage making their roles both more effective and safer. In addition, the improved audio performance of these radios make messages easier to hear. Motorola continues to challenge the TETRA industry with innovations in the radio portfolio bringing real benefits to end users and to their effectiveness in the tasks to which they are assigned.

WHAT THE USERS SAY

"THE MTP3250S HELD ONTO THE TMO SIGNAL MUCH BETTER THAN OUR EXISTING RADIOS".
TECHNOPOL, SLOVAKIA

PLEASE DON'T FORGET THAT THE TYPICAL PERFORMANCE OF THE NEXT GENERATION RADIOS IS EVEN BETTER THAN THE GUARANTEED SPECIFICATION, AND SO THE USER EXPERIENCE WILL BE EVEN BETTER MOST OF THE TIME.

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