Building QUASI-SYNCHRONOUS for low maintenance

In the context of Wide Area Cover Radio systems the term Quasi-Synchronous previously made many maintenance budget controllers feel faint. Maintenance was seen as a never-ending nightmare; this is no longer the case. David Cahill of Dalman Technical Services clears the air.

There is no getting away from the fact that modern properly planned and installed Simulcast systems do work. Most of the long term effectiveness of the technique relies upon the stability of particular system parameters. Historically, maintaining synchronization throughout the network was difficult, time consuming and required test equipment not found in a maintenance technician's tool kit. The problem lay quite simply in the fact that the system hardware was not stable enough in respect of certain parameters. The lack of stability can be attributed to two areas – the transmitter frequency and system audio parameters – both of which can now be tightly controlled using system hardware available today.

Maintaining base transmitter frequency.

By selecting a base transmitter which can be driven by an external source advantage can be taken of the availability of a common frequency source which, by virtue of being common, will provide relative stability, It happens that these sources are highly accurate. Common frequency referencing may use, off-air, a source maintained by a standards agency and radiated for that purpose, or a periodic pulse which is available from the Global Positioning System. Maintenance effort – very low.

Maintaining audio parameters and conditions

There are four audio conditions which need to be maintained. Today the connection between node and base station is likely to be via dynamically switched networks; these use, re-routing, flexible buffering, re-framing and bit-stuffing processes, as part of their methodology. This method of transmission results in changes to the audio relationships within the Quasi network thus degrading the system. There are two manifestations of this process on the perception of the user to system performance. The change may be small in which case the degradation of the system may be slight, but over a period and after several changes the system acquires a reputation among its users as being unreliable and almost unusable; the change may be so subtle and over such a period that none of the users have experienced anything else in this system. Alternatively there may be major and frequent re-routing, the effects can be serious enough to cause the operator to take the system out of service.

- Group Delay refers to the unfortunate property of analogue circuits to delay some frequencies more than others. The characteristic of the distortion changes as the length of the (analogue) line changes. This distortion is compensated for by a circuit in the system which is adjusted to equalize the distortion. Whilst this problem still exists its impact is diminishing because the telephone/line companies are increasingly using digital techniques, which do not exhibit the characteristic, to transport the signals. Maintenance effort – reducing all the time, keep your eye on it.

- Bulk Delay, simplistically the time taken for the signal to travel across the line, is probably the most affected by re-routing. Although automatic compensation sub-systems have been available for a number of years early systems could only operate in a limited geographical area; however, recent developments have removed this restriction. Automatic compensation sub-systems have overcome previous maintenance issues. Maintenance effort – very low.

- Line Reversal. The problem occurs when the audio signal is inverted in the circuit between the node and the mobile. The distortion in the system can not be compensated for by adjustment of the bulk delay. This problem can occur anywhere in the network but is probably not subject to frequent variation. Two techniques are available to compensate for any line changes - an audio 'carrier and sideband' technique or an automatic compensation circuit – but these do not compensate for reversals in the Line / Transmitter interface. . Maintenance effort – very low with competent staff.

- Amplitude Variation. The amplitude of the audio signals being applied to the transmitter modulation circuits have a direct bearing on the modulation levels and hence on any multi-path 'mixing' process in the mobile receiver. Hardware is available which either compensates automatically or facilitates remote manual adjustment of base station interface sensitivity. Maintenance effort – very low.

What happens when things do go wrong?

Providing information to the maintenance crew also has a bearing on the overhead. Modern Quasi infrastructures have extensive local and remote interrogation facilities enabling rapid access to system status from a central point.

In Conclusion

Remember that it is the relative stability of one site on the network compared to another that is the objective. Providing the system has been well designed and installed there is no reason why the maintenance overhead should be greater than that of alternative systems.