UPGRADE WITH GAIN

Planning to upgrade your network to 750 MHz or even 890 MHz ? Relocating Amplifiers is the biggest practical obstacle. Scientific Atlanta offers a solution to through a higher Amplifier gain.

INTRODUCTION

Almost all cable networks in the country currently provide a down stream bandwidth of atleast 300 MHz. Most networks in the larger towns and cities are capable of either 450 MHz or 550 MHz delivery. With an ever increasing number of channels, several leading networks are already upgrading their distribution plant to a 750 MHz bandwidth. Some are even considering a direct jump to 890 MHz. Cable attenuation rises proportional to the square root of the frequency. Hence the cable loss at 750 MHz is 17% higher than the cable loss at 550 MHz. As a result the number of amplifiers on the network will have to be increased and these increased number of amplifiers will be spaced 17% closer together, for a 750 MHz system, compared to a 550 MHz system. Before we take a closer look at the upgrade, let us review the constraints in setting amplifier levels.

LEVEL SETTING

A very detailed two part series article, run a few months ago, has discussed in detail the ideal (input and output) levels for CATV amplifiers.

INPUT LEVELS

Without dwelling too much on the details, the ideal recommendation for long cascades is to have the amplifiers located so that the lowest level input (usually at the highest frequency e.g. 550 MHz) to the amplifier is approximately 70 dBU. As the input level falls lower, noise will accumulate rapidly on a long cascade of amplifiers. As a result, the furthest point customer will receive a "snowy" or "grainy" picture even though the signal levels to the TV set are above 60 dBU for that channel.

OUTPUT LEVELS

On the other hand as the output level of the amplifier is raised, the output signal gets distorted. Infact, distortion increases by 2 dB for every 1 dB increase of output level. This implies that any CATV amplifier will generate 10 dB more output distortion at 105 dBU than at 100 dBU. Most CATV amplifiers manufactured in India utilise the Motorola 6342 IC or its equivalent from Philips. These ICs provide excellent price to performance returns. Given this technology, the ideal signal levels for a reasonably large cascade of 10 to 15 amplifiers would require the input level set at approximately 68 dBU to 72 dBU and the output level at 98 dBU to 100 dBU.

AMPLIFIER GAIN

An input level of approximately 70 dBU and a maximum output level of 100 dBU implies that the amplifier would provide a gain of approximately 30 dB. Hence 2 amplifiers are separated by cable which has a total loss of approximately 30 dB at the highest channel. Assuming that the distribution plant currently provides 550 MHz delivery with 500 series trunk cable, the amplifiers would be spaced at a distance of 400 meters.

DISADVANTAGES OF HIGH GAIN

When the Indian cable tv market was emerging several years ago, cable operators were often attracted by amplifiers offering 40 and even claiming 60 dB of gain. When considered by itself, high gain implies that the amplifier could compensate for a much larger cable loss. Hence, uninitiated cable operators mistakenly thought that amplifiers with 40 dB to 45 dB gain would be an excellent money saver since they could use fewer amplifiers or poorer quality cable with higher loss. Unfortunately, as in most engineering matters, easy solutions just do not exists. An amplifier with higher gain e.g. 45 dB would have to be fed with an input signal of 60 dBU and it would yield an output of 60 + 45 = 105 dBU. Such an amplifier would suffer the worst of both noise due to the low input signal and very large distortion due to the high output level. Cable operators quickly realised that high gain amplifiers did not provide a feasible solution. There after, most main stream amplifier manufacturers rationalised the gain available on their products to approximately 30 dB.

AMPLIFIER CHANNEL LOADING

Just as an empty truck will offer superior performance than a fully loaded truck similarly a cable tv

amplifier's performance gradually reduces as the number of channels transmitted increases. The amplifier by itself does not contribute additional noise for an increased number of channels. This ofcourse excludes the additional noise generated at the headend itself as a result of the combination of additional channels, due to the out of band noise contributed by each modulator. The "channel loading" deteriorates the output distortion from an amplifier. Doubling the number of channels increases distortion by 3 dB. Hence increasing the number of channels from 67 for a 550 MHz system to 106 for an 890 MHz system will imply that the distortion will increase by approximately 3 dB, all other factors being equal. An amplifier designer therefore has to be wary of increasing noise when designing amplifiers that provide larger bandwidths. This is an important factor when considering upgrades from 550 MHz to 890 MHz which provides for twice the number of channels. Readers should be wary of amplifier manufacturers that provide their output distortion figures as per din standards which call for only a 2 channel loading. No modern day cable tv network currently restricts delivery to a mere 2 channels. Such figures therefore provide a mis-leading rosy picture of the specifications. On the other hand, the BIS (Bureau of Indian Standards) clearly requires distortion to be stated with a full loading of the number of channels.

AMPLIFIER SPACING

If the system is to be upgrade to 750 MHz, on the same trunk line with hybrid amplifiers again providing approximately 30 to 32 dB of gain, the amplifiers would now have to be spaced at intervals of 350 meters. This shorter distance would not only mean the use of more amplifiers throughout the system but in practice also require that the amplifiers are repositioned in different locations. As any field technician will tell you, this is not as easy as it would seem.Besides the location of the amplifier, the other practical problem is that the trunk cable will have to be cut at a new location and a joint added at the old location. Cuts and joints are always not very desirable and can lower system reliability and integrity.

AVOID RE-LOCATION

Given the practical difficulties in relocating amplifiers, Scientific Atlanta, USA, a leading manufacturer of CATV hardware has proposed an alternate technique for system upgrade.
Scientific Atlanta have designed their LE3 Amplifier for 750 MHz operation and their Gainmaker Amplifier for 870 MHz operation. Both these designs have been optimised for easy upgrade for existing 550 MHz systems.

BREAKING THE RULES

Both the LE3 and Gainmaker Amplifiers provide a higher gain. The LE3 offers a total gain of 34 dB at 750 MHz and the Gainmaker provides 36 dB gain at 870 MHz. At first sight, providing a somewhat higher gain may seem simple, almost trivial. However, consider the higher gain, in light of what has been said earlier.A higher gain of approximately 6 dB would imply that the amplifier would be capable of delivering a 6 dB higher output level without higher distortion, or handling 6 dB lower input signals, without adding significant noise, or handling a 3 dB lower input signal & a 3 dB higher output level, without deterioration in the amplifier specifications. The new SA amplifiers adopt this third alternate.Keep in mind that these superior specifications are to be achieved along with the additional burden of the number of channels to be carried. The "Gainmaker" amplifier needs to deliver almost twice the number of channels at 890 MHz, compared to a 550 MHz product ! This increased channel loading itself carries with it a 3 dB additional penalty on the specs.

REQUIRED SPEC

To summaries, the required specifications for a drop in upgrade amplifier, would demand 6 dB higher gain, a lower noise figure, a higher output, all with the additional burden of 106 Channel loading, instead of 67 Channel loading at 550 MHz. The new products offer a Noise figure of 7.5 dB at 750 MHz for the LE III and 6.5 dB at 870 MHz for the Gainmaker, as compared to approx. 9 dB at 750MHz for conventional trunk amplifiers. A comparison of output levels & distortion (Composite Triple Beat - CTB) shows that the LE III achieves -67 dB at an output level of 106 dBU, and the Gainmaker offer -68 dB at 106 dBU, compared to conventional products that offer -59 dB at 106dBU @ 750 MHz or -65 dB at 106 dBU output @ 550 MHz.

SUMMARY

All put together, the specifications required for a simple drop-in replacement are very demanding & have been achieved using state-of-the art components & design techniques. Just simple additional gain will not provide a solution, but can lead to very poor performance in terms of both, noise & distortion.The solution provided by the new range of Scientific Atlanta amplifiers is very elegant & provides a smooth & simple upgrade path to 750 MHz or even 890 MHz systems, by using the amplifiers as drop-in upgrades. However, there is a huge amount of new technology that has gone into the making of the advanced products. As with all good ideas, imitations are sure to emerge quickly.
However, the customer needs to be wary of any quick solutions that are offered, that simply provide additional gain, without addressing the associated issues such as lower noise & higher output levels that are essential for proper implementation of the solution.

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