TRIAX Press

Complicated in theory - simpler in practice

Article by Product Manager Poul Knudsen, Triax

Conversion to digital signals can significantly increase cable capacity in CATV and SMATV networks. Transmodulators are available at prices that are feasible also for small networks, and installation is much simpler than the theory behind the technology.

Poul Knudsen has been Product Manager at TRIAX for headends since 2001 and is the key person in bringing Triax's *"simply more - more simply"* concept into the products. The result is the Triax TDH 700 headend, where important features like operation and installation are outstanding simple.

Viewers want it, and broadcasters offer it. All over the world the number and variety of TV-channels explode and TV-users can pursue their individuality and special interests in sports, entertainment, documentation and news at local, national and international levels.

Network capacity is the great limitation and perhaps especially in smaller networks, where users feel some degree of local “ownership”. When something is free, in the air and in demand, consumers have little respect of technical excuses for not being able to watch it and in frustration some users may invest in individual solutions. Network operators loose subscriber loyalty and - even more tangibly - loose revenue from carrying extra programmes.

Lots of technical solutions are available to increase network capacity but most of these require substantial investments in for example a fibre optic trunk or a large-scale changes of headend or network components. One cost-efficient solution is however available and deserves more attention. Reasonably priced QAM transmodulators can receive and re-modulate the total contents of one satellite transponder to another digital form and thereby substantially increase the capacity in existing cable networks.

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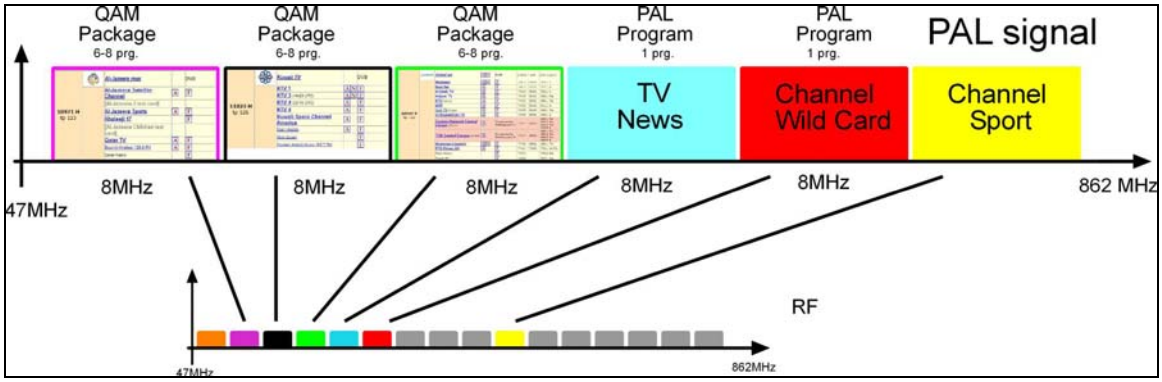
Increase capacity with up to a factor 10

It is well known, that digital channels take up less cable capacity than analogue channels. The capacity effect of digitalisation is dependent of the applied digital modulation form. As shown in the diagram below QPSK modulation according to DVB-S standard increases capacity with a factor 2, while QAM modulation (DVB-C standard) will allow you to distribute all channels from one satellite transponder (typically 6-8 channels) in the 8 MHz used by one analogue channel.



Number of channels within 8 MHz bandwidth and different types of modulation. DVB-C uses QAM modulation and allows the largest number of channels per 8 MHz.

What is QAM?

QAM (Quadrature Amplitude Modulation) is a globally accepted, digital transmission standard and is integrated in the DVB-C standard (see www.dvb.org). It is a 2-dimensional modulation form based on a combination of amplitude modulation and phase shift keying. To cable network operators it is however more important that

A. QAM signals only require little bandwidth (8 MHz) but can use the high effect levels in cable networks (compared to DVB-S satellite signals where bandwidth is required and available - and where effect levels are low)

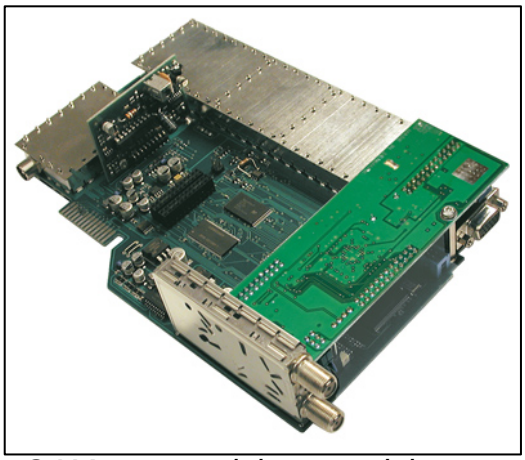
B. QAM signals use of 8 MHz fits into the existing channel raster, where 1 analogue channel also uses exactly 8 MHz and can be replaced with a QAM signal = all channels received on a specific transponder

When working with QAM modulation you will meet expressions for different degrees of compression: 32-QAM uses 5 bits pr. symbol, 64-QAM uses 6 bits pr. symbol and 256-QAM uses 8 bits pr. symbol. With a high degree of compression, as in 256-QAM, signals are vulnerable, and it is generally accepted that 64-QAM in TV networks gives the right trade-off between capacity needs and the need to ensure quality signals. So, in practice you will typically use 64-QAM but with most transmodulators you can easily shift between 2 or 3 different levels of compression.

QAM transmodulators are easy to install

QAM transmodulators are available from most headend manufacturers as plug-in headend modules. Some manufacturers also offer stand-alone modules for use in installations, where insertion into an existing headend is impossible.

Operators and installers in reality need no knowledge of the theory behind QAM modulation. The transmodulator is configured by use of a programming unit that can be used directly or can be connected to a Windows PC. Configuration is very similar to configuration of a set-top box and most manufacturers have invested in design of a user-friendly and time-saving interface.



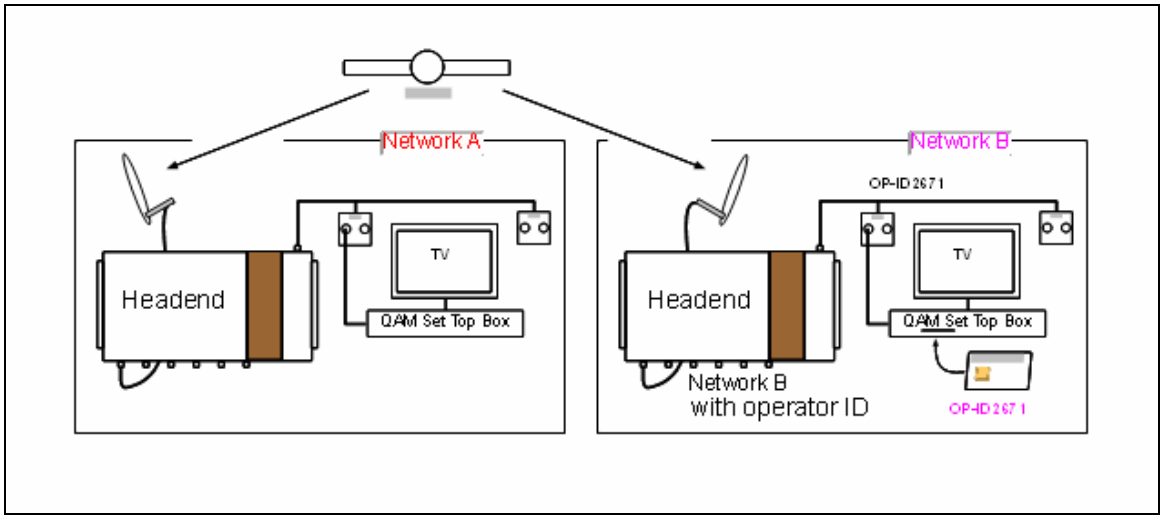
QAM transmodulator module available as headend module

A transmodulator handles all channels on one satellite transponder and typically you will of course insert transmodulators where you obtain the maximum net increase in network capacity. If you are already distributing four channels from a selected transponder, digital compression “releases” 3 channels (3 x 8 MHz) in addition to distri-bution of all channels on the transponder.

QAM seen from the user side

On the user side, the technology requires a QAM set-top box in each home. It is however a one-time investment at a very moderate level, and typically network operators have little difficulty in marketing the benefits of more programs at the costs of a set-top box. Most headend manufacturers also manufacture set-top boxes and can include these in their offer to operators.

Whether transmodulators only give access to free-to-air channels or also give interested users access to pay-TV depends on the transmodulator and on the broadcaster.
QAM transmodulators are available in simple transparent versions exclusively for free-to-air channels but also in versions that can handle operator-IDs, and where a smart card in the set-top box gives users access to pay-TV. The price difference between the simple and the more advanced transmodulator is marginal and the more advanced product also provides other benefits as you can see below. Access to pay-TV from a QAM set-top box however requires a special version of the smart card provided by the broadcaster. In Europe, where QAM modulation to a large extend is used to provide access to pay-TV, broadcasters of course now offer a QAM version of their smart card, and we will expect a similar development is on its way in other countries with a wide choice of TV-channels.



Besides free-to-air versions, QAM transmodulators are now also available in versions that can handle operator ID's and Smart Cards

Manipulation of data

QAM modulation is principally and in its basic form a completely transparent type of modulation: The transport stream and service information in the multiplex is transformed without any changes from QPSK to QAM.

The more advanced QAM transmodulators however allows manipulation of the signals and there are occasions, where you will want to add or change information in the package. One example is insertion of an operator ID as mentioned above. The transmodulators that

allow this type of change however also opens up for other types of manipulation, namely NIT manipulation and insertion of stuffing bytes.

Most set-top boxes search by means of preset symbol rates, and insertion of stuffing bytes (adding bytes) may be needed, if signals don't fit with the symbol rates defined in the set-top boxes.

Also NIT manipulation has to do with the fit between signals and the pre-settings of the set-top box. The Network Information Table (NIT) is a table of service information included in the multiplex and correct settings is not a must, but significantly eases set-top box configuration and search. The illustration below shows an example of NIT from satellite and the same NIT after manipulation with the parameters selection and format expected by the set-top box.

NIT from satellite	New NIT to the cable net
• Satellite delivery system descriptor	• Cable Delivery System Descriptor
• Frequency 32 bit 0x01180420 11.80420 GHz	• Frequency 32 bit 0x05460000 546.0000 MHz
• Orbital position 16 bit 0x0130 13.0 degrees	• Reserved (future use) 12 bit 0xFFF
• West/east flag 1 bit east	• FEC outer 4 bit 2 RS(204/188)
• Polarisation 2 bit 1 liniear – vertical	• Modulation 8 bit 0x0364 QAM
• Modulation 5 bit 1 QPSK	• Symbol rate 28 bit 0x0068750 6.8750 Msymbol/s
• Symbol rate 28 bit 0x0275000 27.5000 Msymbol/s	• FEC inner 4 bit 15 no conv. Coding
• FEC inner 4 bit 2 2/3 conv. Code rate	

*Manipulation with the **N**etwork **I**nformation **T**able NIT*

Data manipulation (inserting Operator ID, NIT manipulation, inserting stuffing bytes) is defined in configuration of the QAM transmodulator, where a user-friendly
in the programming unit or PC guides the installer through the choices in step-by-step procedure.

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Digital headends available for small networks

As mentioned, QAM transmodulators can be inserted into an existing CATV/SMATV system as stand-alone units and with the sole purpose of increasing the number of channels carried in the network. But as a network operator you may also consider to use this opportunity as an occasion to introduce a compact, digital headend in your system.

Triax Digital Headend (TDH 700)

A number of digital headends are available at prices and with features that are attractive also to networks, where subscribers are counted in hundreds. A digital headend will allow the network operator to distribute the growing number of digital TV-channels, including digital, interactive services. In many cases new technology furthermore will reduce the costs of network operation, because the compact, modular headends are easy to control and update. In relation to QAM transmodulators a digital headend will facilitate configuration and control. It is not a must but the headend provides a uniform, user-friendly programming interface to all digital modules, including QAM transmodulators, and allows remote access from anywhere to the system.