BROADCAST DISTRIBUTION TO TOWERS

Broadcast Distribution to Towers

This Solution Overview gives an overview of the most common Digital Terrestrial Television (DTT) primary distribution architectures involving satellite. Attention is paid to the role of efficient usage of the satellite payload in order to minimize OPEX costs.

There is no single architecture which is the most optimized for all DTT network deployments. There are a number of commercial and technical parameters which influence the choice to make. These cover, but are not limited to, the commercial parties involved in the project, the commercial constellation, any legal constraints, whether the deployment is analog or first generation DTT, the geographical situation, the terrestrial access to the towers, the future prospects of the deployment the commitment and any timing constraints or obligations imposed by the regulators.

Six architectures are presented in this Solution Overview. For each of these architectures, the commercial constellation involved and the pros and cons of the architecture versus this constellation are elaborated.

- Plain DTT distribution for DVB-T, DVB-T2 and ISDB-T
- High efficient DTT distribution with more sources
- Interactive broadcast to DTT towers
- DTT distribution with regionalization
- DTH and DTT distribution with or without regionalization
- DTT with remote uplinks for regionalization

DIALOG

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Plain DTT Distribution for DVB-T, DVB-T2 and ISDB-T

The national content provider delivers a number of video channels. These are statistical multiplexed in the video headend. The result is a Multiple Programs per Transport Stream (MPTS) fitting one DVB-T channel. The SFN Adapter inserts necessary control and timing information for DVB-T transmission. The DVB-T multiplex (mux) is the input into the M6100 modulator.
At the remote site, the DVB-S2 demodulator delivers the DVB-T mux to the DVB-T modulator.

In the case of DVB-T2, this scenario still applies. The DVB-T2 Gateway replaces the SFN Adapter. The difference is in the content of the DVB-T2 mux which can now contain several Physical Layer Pipes (PLPs) and, therefore, several MPTS to cope with different receive conditions.

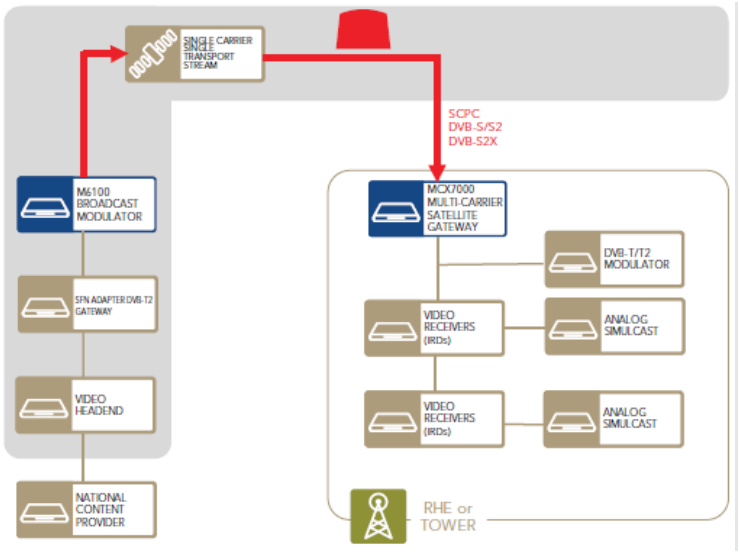
In the case of Analog Simulcast, each and every analog transmission requires a video decoder in the tower. A professional IRD can be used if the stream is a DVB-T mux. For each Analog Simulcast program, another IRD providing the video is required. For a DVB-T2 mux, a DVB-T2-MI decapsulator, connected to the output of the MCX7000 Multi-Carrier Satellite Gateway can deliver the video input for the Analog Simulcast.

The advent of more SD channels and new HD channels creates an understandable desire for more efficient use of the satellite bandwidth. To address this, the M6100 modulator supports Clean Channel Technology®, next to DVB-S2X. The matching MCX7000 demodulator has multiple ASI and GbE outputs which guarantees compatibility with the installed base of IRDs.

This architecture is typical for DTT systems which are deployed initially according to the DVB-T standard and updated overtime according to DVB-T2. The upgrade process from DVB-T to DVB-T2 requires a simulcast of two carriers. A DTT mux can be added by providing an extra uplink carrier. Only one DVB-T/T2 multiplex can be transmitted over one Single Channel per Carrier (SCPC) channel.

- Pros: Simple system architecture, upgrade from DVB-T to DVB-T2 requires minimum investment in the towers by replacement of the DVB-T modulators. Efficiency gains by use of Clean Channel Technology and DVB-S2X require insertion of an MCX7000 only, while preserving the installed base of IRDs. The MCX7000 can also be fitted with extra demods, in case of multiple DTT mux carriers to be received in the towers.

- Cons: Each DTT mux being transmitted over a separate carrier is suboptimal with regard to satellite transponder resources. No means for regionalization, no means for monitoring tower equipment.



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High Efficient DTT Distribution with More Video Sources

National content providers deliver a number of video channels. These are statistical multiplexed in the video head-end. The result is an MPTS fitting one DVB-T channel. The SFN Adapter inserts necessary control and timing information for DVB-T transmission. A number of these DVB-T channels are input into the M6100 modulator. Each DVB-T channel represents one stream of a DVB-S2 multistream.

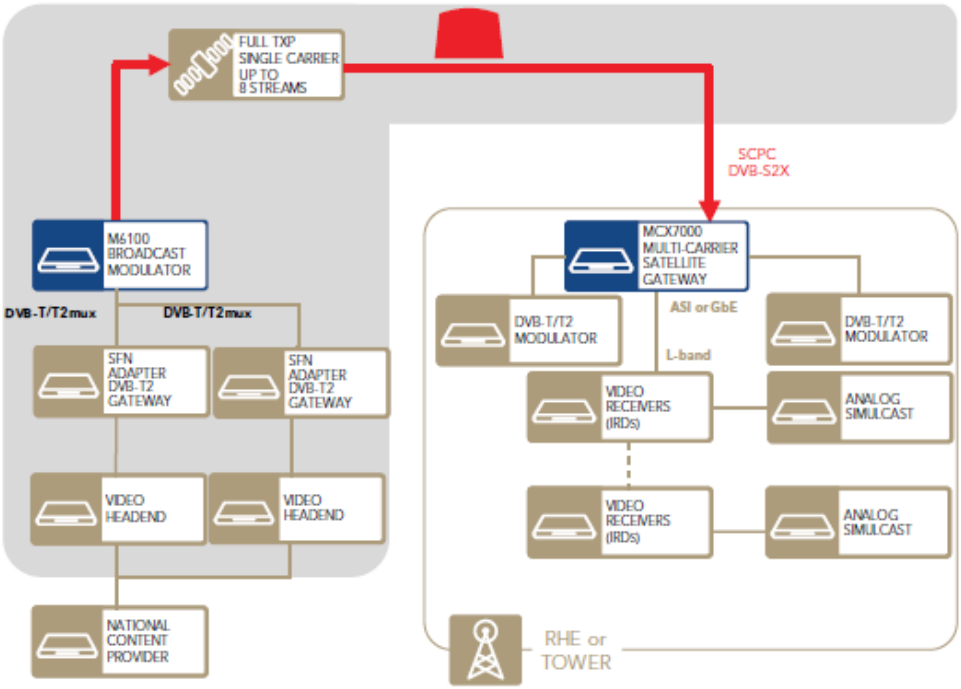
- An efficient transport system over satellite uses multistream DVB-S2X transmission and a matching demodulator such as the MCX7000 Multi-Carrier Satellite Gateway. For SFN compatibility, the Input Stream Synchronization (ISSY) mechanism is used. The demodulator delivers the separate streams (each one making up for one DVB-T mux) to separate DVB-T modulators.

- In the case of DVB-T2, this scenario applies. The DVB-T2 Gateway replaces the SFN Adapter. The difference is in the content of the DVB-T2 muxes which can now contain several PLPs for coping with different receiving conditions.

- In the case of Analog Simulcast, each and every analog transmission is in need of a video decoder in the tower. Professional (Integrated Receiver Decoders) IRDs can be re-used to provide the video input for the Analog Simulcast if the streams are DVB-T mux. For each Analog Simulcast program, another IRD is required. Input to the IRDs can be over Asynchronous Serial Interface (ASI) or IP. If those inputs are not available, the L-band (after transmodulation) output of the MCX7000 may be used as input for the IRDs. In case of DVB-T2 mux, a DVB-T2-MI decapsulator, connected to the output of the MCX7000 can deliver the video input for the Analog Simulcast.

As all DTT mux are transmitted in multistream mode over a single carrier per transponder, the satellite link can work to maximum efficiency.

The application of DVB-S2X results in more DVB-T/T2 multiplexes. Equalink® 3 optimizes the link budget even further.



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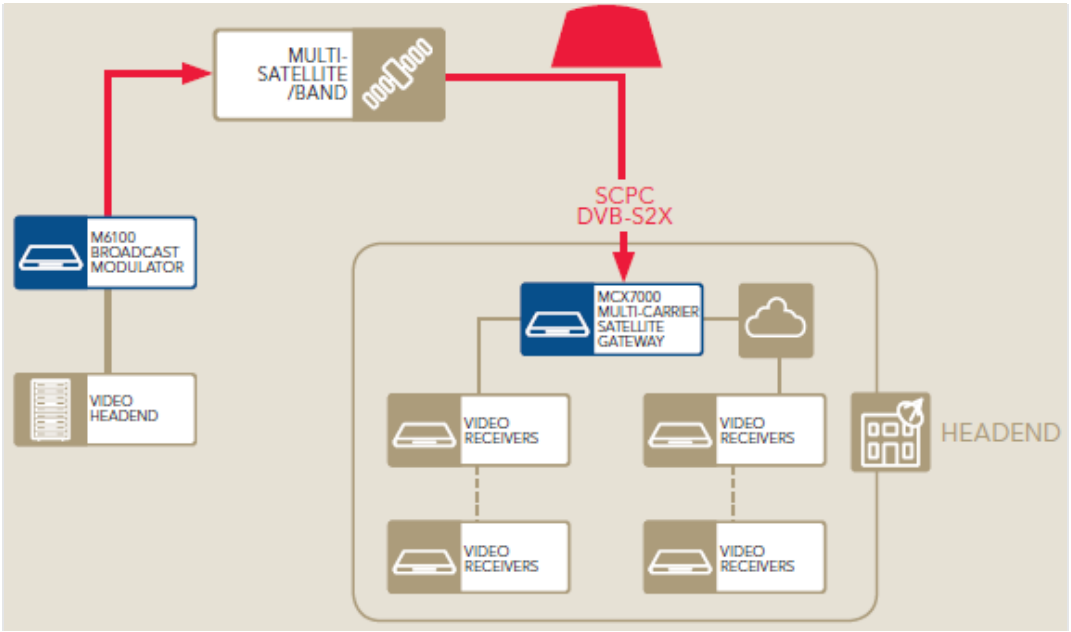
Highly Efficient Primary Distribution Enabling More SD and HD Content

Additional efficiencies in transmission can be achieved by optimizing transmission technologies. By deploying a dedicated MCX7000 receiver in the remote sites, to act as a single frontend to the installed base of receivers, the operator can enable a lot of new transmission technologies, such as DVB-S2X, Multistream and Wideband up to 72 MBaud.

Combinations of one or more technologies can result in additional throughput of over 100% - using the more efficient DVB-S2X, Equalink® 3 pre-distortion in the uplink, and saturating the transponder with a single multi-stream and 72 MBaud carrier.



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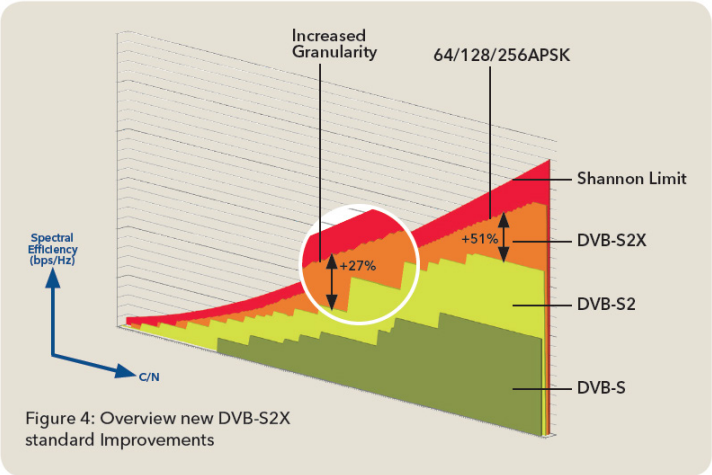

Figure 4: Overview new DVB-S2X standard Improvements

10 Improvements in DVB-S2X

- Smaller roll-offs
- Advanced filtering of satellite carriers
- Increased granularity in MODCODs
- Higher order modulation: 64/128/256 APSK support
- Linear and non-linear MODCODs
- Better implementation of MODCODs
- Wideband support
- Very low SNR support for mobile applications
- Channel bonding
- Additional standard scrambling sequences to mitigate co-channel-interference (CCI)

Bonding multiple carriers together into one large virtual carrier, increases the efficiency gains of statistical mulitplexed video by up to 20%. This will ultimately be a key technology to distribute statistical multiplexed Ultra HD streams containing ten or more TV channels in one transport stream of 160-220 Mbps.

Multistream (DVB MIS) capability allows operators to aggregate a number of independent transport streams or IP streams into one carrier in a fully transparent manner, maintaining the integrity of the original content.

Wideband transmission provides these aggregated streams to be up to 72 MBaud, resulting in one large single carrier to be transmitted over satellite. This allows the operator to saturate the transponder, thereby increasing efficiency by up to 20% through non-linear operation

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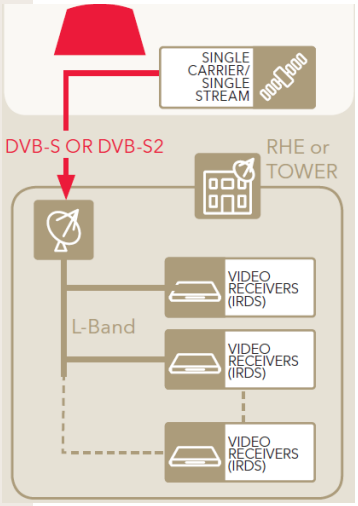
DO YOU KNOW THAT YOU CAN BENEFIT FROM HIGHER TRANSMISSION EFFICIENCY WHILE PRESERVING YOUR INSTALLED BASE OF IRDS?

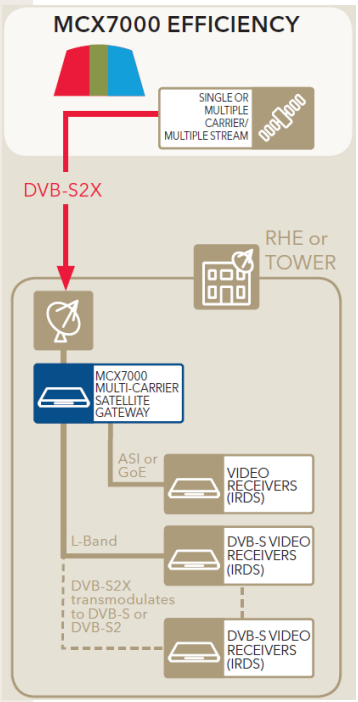
The upgrade of a network from DVB-S to DVB-S2 or DVB-S2X is generally perceived to be very expensive. Indeed, the installed base of IRDs represents a high CAPEX because the IRDs contain multiple functions in one box:

- **L-band satellite reception inputs (DVB-S and/or DVB-S2)**
- **optional GbE and ASI inputs**
- **transport stream decryption**
- **in-band controls**
- **video/audio decoding and transcoding (MPEG-2 and/or H.264)**
- **metadata processing (e.g. cue tones)**



Combining all those functions together in a single box makes the transition to new technologies and standards difficult. In practice, network upgrades are done late in time, at the point where multiple new technologies converge together. As an example, large network upgrades have been triggered by a combined upgrade to High Definition + H.264 + DVB-S2. The business case to roll out new and upgrade existing networks (IRDs) to these new technologies, made sense by combining the benefits of all 3 new technologies together into one investment round. This is of course the result of the fact that IRDs combine all three functions together in a single box.

The MCX7000 Multi-Carrier Satellite Gateway is ideally suited to benefit from a higher efficient transmission in existing networks, or to prepare the network for future upgrades to new video standards. Operators can benefit instantly from higher efficient transmission, while preserving the investment for future upgrades to HEVC and Ultra HD.



The alternative that exists, is to split the different functions in multiple boxes. Depending on the number of channels received per headend, which is ever increasing – it makes economic sense to upgrade the satellite transmission network to a higher efficient transmission using DVB-S2X, while upgrading to HEVC and possibly Ultra HD can be done at a later stage. In this way, distribution networks can instantly benefit from a higher efficient transmission, opening the door to either

- **using less transponder space**
- **distributing more channels without buying more satellite capacity**

The MCX7000 Multi-Carrier Satellite Gateway ideally fits as a satellite front-end feeding multiple IRDs. The MCX7000 receives multiple MPEG-2 transport streams from a single or multiple saturated transponder(s) using DVB-S2X. It then extracts those transport streams and feeds them over ASI or IP into the existing installed base of IRDs. One MCX7000 can be used for tens of TV channels. In case older IRDs have no ASI nor IP input, the MCX7000 can even transmodulate the DVB-S2X multistream carrier into a traditional DVB-S/DVB-S2 singlestream carrier!

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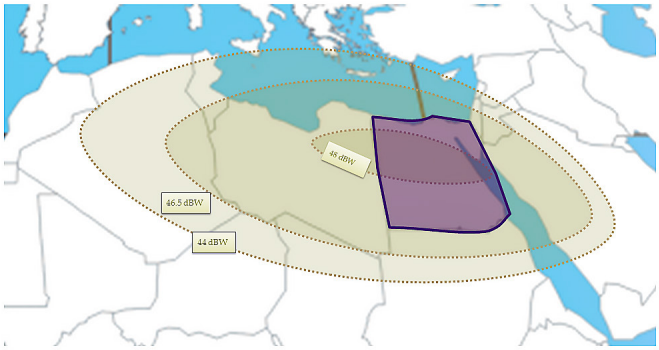
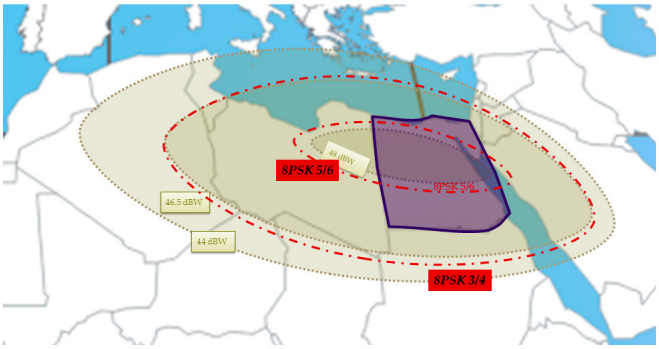
DO YOU KNOW THAT THE HIGHER MODCOD GRANULARITY ALLOWS YOU TO MATCH THE SATELLITE FOOTPRINT OPTIMAL TO THE GEOGRAPHIC REGION?

Assume the following example:

We want to cover the purple region with a satellite distribution system. The satellite EIRP is depicted on the map and is determined by the transmission efficiency, service availability and size of the satellite terminal.

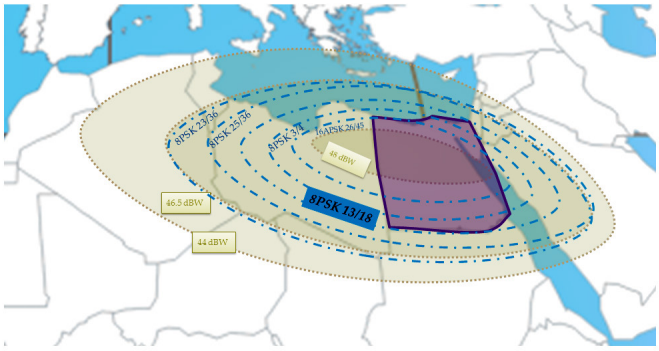




Using **DVB-S2 20%** roll-off, 8PSK 3/4 is the best match to achieve a defined availability with a certain terminal size. The higher modulation 8PSK 5/6 cannot be used since the full geographic region is not covered.

Using DVB-S2X with a higher MODCOD granularity, allows the selection of 8PSK 13/18 modulation to much better match the target footprint. This MODCOD results in 16% bitrate gains compared to DVB-S2, without compromising service availability!

Alternatively, customers can opt to achieve the same bitrate from DVB-S2X as DVB-S2, while benefitting from smaller dish sizes!



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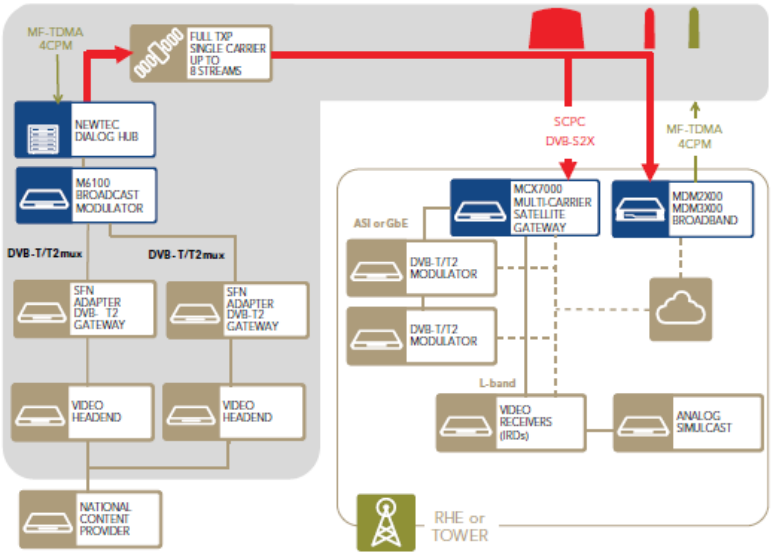
Interactive Broadcast to DTT Towers

For larger deployments where the amount of received DTT muxes may be up to 8, a monitoring and control facility in the central headend of all tower equipment (DTT sites) is a necessity.

Newtec Dialog® system provides the right tools for remote monitoring and management. The hub in the central headend and a MDM2x10/3x10 low cost modem at the DTT site provide everything that is needed for over the air management.

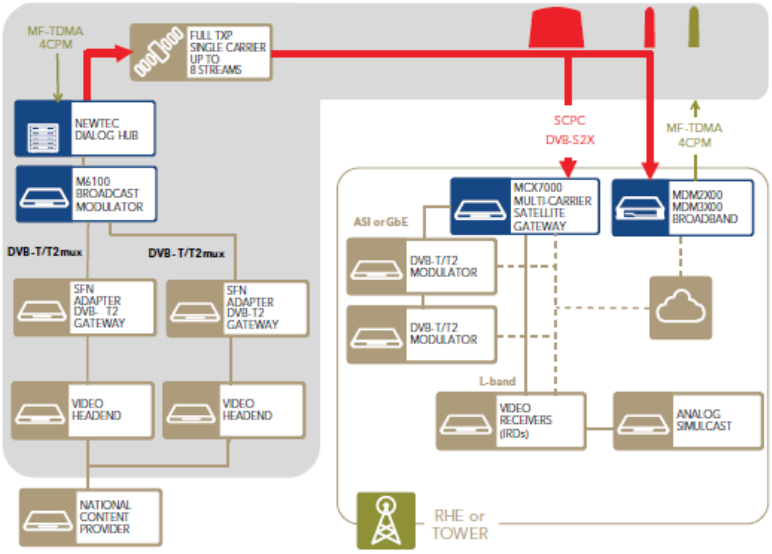
The forward channel is another stream added to the multistream transmission. The return link can make use of Newtec's Dialog MF-TDMA return channel or can be terrestrial.



DTT Distribution with Regionalization

One way of inserting regional TV services is by aggregating the national content with regional content.

Each region provides its content to the central headend. This content should be an SPTS or MPTS stream, input to the DVB-T2 Gateway. There is one Gateway per region.
Each region receives, next to its regional content, an MPTS with national content in a dedicated PLP.



This means that each DVB-T2 mux contains national content. In order to minimize the burden due to the replication of the national content in each and every DVB-T2 mux over the satellite link, multistream transmission is used in its most efficient way with DVB-S2X transmission, in combination with Equalink® 3. The set-up is optimal if a full transponder is filled up and used in saturated mode in which case Equalink® 3 is most efficient. DVB-S2X for enhanced efficiency over satellite results in more DTT multiplexes.

As an alternative to each DVB-T2 mux containing the national content, PLP substitution or aggregation can be used. PLP substitution or aggregation allows for the rebuilding of the SFN compliant mux at the tower site by adding or replacing a PLP locally. This however requires extra inserter equipment in each and every tower.

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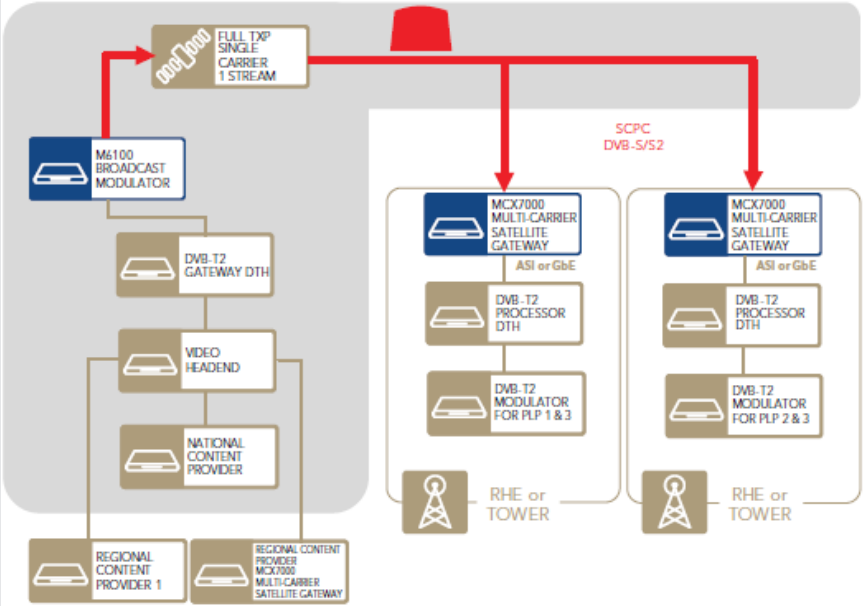
- Pros: Maximum efficiency of satellite resources, for national and regional content, flexibility with DVB-T2, optional remote monitoring with the Newtec Dialog system, no extra equipment in the towers other than the satellite demodulators and the DTT transmission equipment.

- Cons: For new deployments only, requires DVB-S2X and DVB-T2, replication of national content per region or aggregation, regional video input via the Central headend.

DTH and DTT Distribution with or without Regionalization

In order to optimize satellite transponder utilisation and at the same time have a DTH back-up for 'black spots', all national and regional programs are bundled in one DTH multiplex, together with other FTA or Pay TV DTH services.
Each region provides its content to the central headend. This content should be an SPTS or MPTS stream, input to the video headend (Statmux).

There is one DTH-type DVB-T2 Gateway per DVB-T2 mux, adding the T2 signalling information for SFN networks. This signalling information defines the national (PLP 3) and regional PLPs (PLP 1 and 2).



The typically Free-To-Air (FTA) DTT content is complemented with other FTA or Pay TV DTH channels.

The DVB-T2 Edge equipment in the towers re-assembles the DVB-T2 mux per region, based upon the signalling information from the DVB-T2 Gateway. SFN compliance is preserved.

This architecture is beneficial as long as there is only one DVB-T2 mux per tower and if the DTH bouquet can fill up a full transponder with national and regional channels or (Pay -TV) DTH channels apart from the DVB-T2 channels.

Note that the national channels can fill up maximum 40 Mbps per T2 mux. The number of DVB-T2 mux per transponder is limited anyway by the T2 Gateway capabilities. If several DVB-T2 mux are transmitted per tower, each will require a DVB-T2 Edge equipment.

Equalink® 3 enhances efficiency in DVB-S2, 8PSK mode.

The set-up is optimal if a full transponder is filled up and used in saturated mode in which case Equalink® 3 is most efficient. Future DTH deployments in DVB-S2X 16APSK mode will enhance efficiency. The effect of Equalink® 3 is also greater in this mode of operation.

- Pros: Re-use of DTH transmission.
- Cons: The low efficiency over satellite as DTH type of modulation and coding is needed and the need of DVB-T2 Edge equipment per tower and per DVB-T2 mux, loss of flexibility as depending on DTH.

DTT with Remote Uplinks for Regionalization

In case commercial or technical constraints prohibit the regional programs to be received by the video headend, a distributed uplink scheme is possible. This means each region uplinks its content to the towers. This content should be an SPTS or MPTS stream, input to the video headend (Statmux). There is one DVB-T2 Gateway per DVB-T2 mux.

The local DVB-T2 Adapter in the towers re-assembles the DVB-T2 mux per region. The regional PLP placeholders in the national content T2-MI stream are replaced by regional content. The SFN compliance is preserved.

This architecture reduces OPEX as the national content is transmitted only once over satellite.

On the other hand, efficiency over satellite is low as this is a multi- carrier per transponder constellation which prevents any bandwidth optimisation technologies, such as Multistream and Equalink ®3.

The CAPEX can be quite high. Regional uplink station infrastructure and extra receive equipment (one per received carrier) and the T2 Adapter all add to the overall cost. Fortunately, the MCX7000 is able to resolve this, as it can receive up to 3 carriers. DVB-S2X transmission will enhance efficiency over satellite.

BENEFITS OF NEWTEC'S ST ENGINEERING IDIRECT'S TECHNOLOGIES FOR BROADCAST INTERACTIVE PRIMARY DISTRIBUTION

FLEXIBILITY

- Breadth of choice for satellite RF interfaces as well as audio/video interfaces
- Agnostic to video compression technology (MPEG-2, H.264, HEVC)
- Agnostic to video format (SD, HD, Ultra HD ready)
- Supports video, audio and data distribution and exchange
- Integrated with all leading manufacturers of video headends and distribution systems (Cisco, Arris, Harmonic, Ericsson, etc..)

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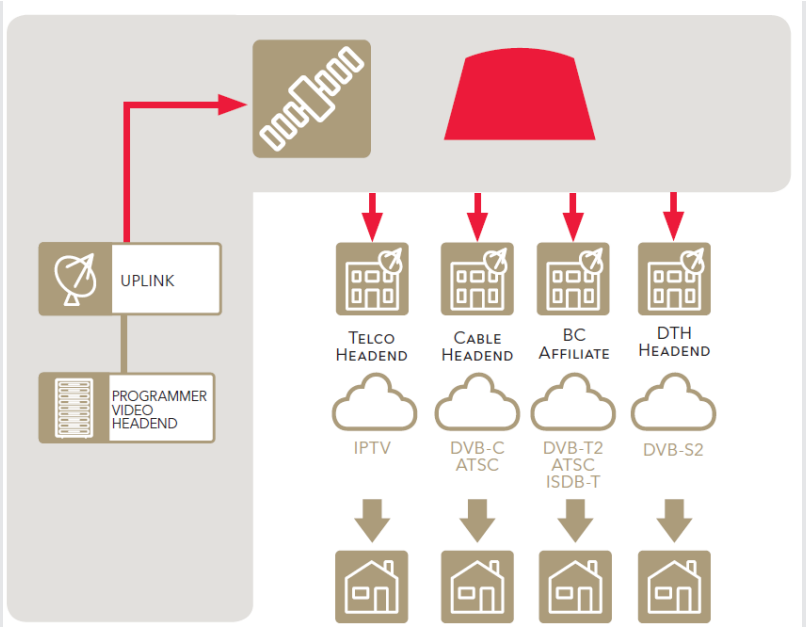

Conclusion

- Optimum DTT architecture depends on a lot of factors to be assessed at system architecture design. This architecture will often evolve over time.
- Equalink® 3, Multistream, DVB-S2X and Clean Channel Technology on its M6100 modulator and MCX7000 Multi-Carrier Satellite Gateway enable the best possible performance over satellite, independent of the DTT architecture of choice.
- The Newtec Dialog system enables central monitoring of all tower equipment.

SCALABILITY

- Turn a traditional distribution network into a more efficient interactive distribution network while preserving installed base of infrastructure
- Re-use existing IRDs in all growth scenario's, including NMS and encryption:
- no operational changes
- Add file distribution and exchange to traditional live distribution

EFFICIENCY

- Use highest modulation efficiency including SW upgrade to DVB-S2X
- Clean Channel Technology works with a lot of professional receivers up to 10% roll-off
- Full transponder saturation with DVB multistream
- Efficient transponder utilization using linear and non-linear Equalink® 3
- High performing and patented demodulator : better link margin and RFI resilience compared to silicon based IRDs
- Fast troubleshooting of video headend using real-time transport stream analyzer in all modulators

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