Newtec

White Paper

A TALE OF 3 SATELLITE RETURN TECHNOLOGIES

Newtec Dialog®: MF-TDMA, SCPC and Newtec Mx-DMA™ to the Test

Introduction

The introduction of the Newtec Dialog® platform in the Satcom marketplace coincides with the introduction of other innovations, such as High Resolution Coding (HRC™), Cross-Dimensional Multiple Access (Mx-DMA™) and Newtec S2 Extensions.

Newtec Mx-DMA return technology provides 35% gains in bandwith efficiency compared to SCPC fixed rate links and 50% against MF-TDMA links.

Newtec Dialog is a scalable, flexible and efficient multiservice platform that allows satellite service providers to build and adapt their infrastructure easily as their business and the satellite market grows. Newtec Dialog gives operators the power to offer a variety of new services on a single platform. For these services, the platform will always use the most efficient modulation and bandwidth allocation.

Satellite service providers continuously seek new ways to improve the efficiency of their satellite networks in order to counter high bandwidth costs, increase profitability or push more content over satellite. Not only is the efficiency of the forward link important, but so is the return path (from the remote site back to the hub).

This technical note will focus on the efficiency gains achieved with the Newtec Dialog platform through the different available satellite return technologies (SCPC, MF-TDMA and Newtec patented Mx-DMA). The note is based on the Newtec White Paper on Newtec Dialog: "Change is Inevitable and Progress Is Possible", which provides more information on the market environment and the different building blocks for the multiservice platform.

Matching Satcom Return Technologies and Applications on Newtec Dialog

Three types of return technology are available to the satellite service provider on the Newtec Dialog platform to configure his network: MF-TDMA, SCPC and the new patented Newtec Mx-DMA.

Legacy platforms typically resort to the following two return technologies:

- MF-TDMA typically targets applications with bursty (and potentially over-booked) traffic services, such as Internet access for consumers and private SME, B2B and SCADA networks.
- SCPC on the other hand has more applicability in high data and video rate return links.

In between there are a large number of applications with low to medium overbooked services and throughput rates up to more than 20 Mbps (and more). These applications are enterprise/ corporate networks, government/NGO networks, cellular backhauling and broadcast contribution networks.

A large part of the market is caught up in the SCPC versus MF-TDMA dilemma. And the end-user? He does not really care as long as he gets the right service level for the right price. Some technologies in the market already allow a (semi) dynamic switch between SCPC and MF-TDMA but that goes hand-in-hand with a considerable satellite outage time, packet loss and sub-optimal usage of the link.

Newtec Mx-DMA to the Rescue

Newtec introduces a new return link technology that will rock the satellite market: Mx-DMA, also known as Cross-Dimensional Multiple Access. Mx-DMA combines the best qualities of SCPC and MF-TDMA technologies and solves the difficult choice of having to select one or the other.

In other words, on the one hand the new satellite return technology will provide MF-TDMA-like on-demand variable bandwidth allocation. On the other hand, Mx-DMA uses Newtec HRC and modulation which results in DVB-S2 SCPC-like efficiencies (from QPSK up-to 32APSK), and a very fine MODCOD granularity using 40 distinct MODCODs.

Combining the benefits of MF-TDMA and SCPC in a single Mx-DMA technology also ensures low jitter and delay in the satellite network and excellent packet-error-rate performance, making Mx-DMA well suited for voice and video streaming applications.

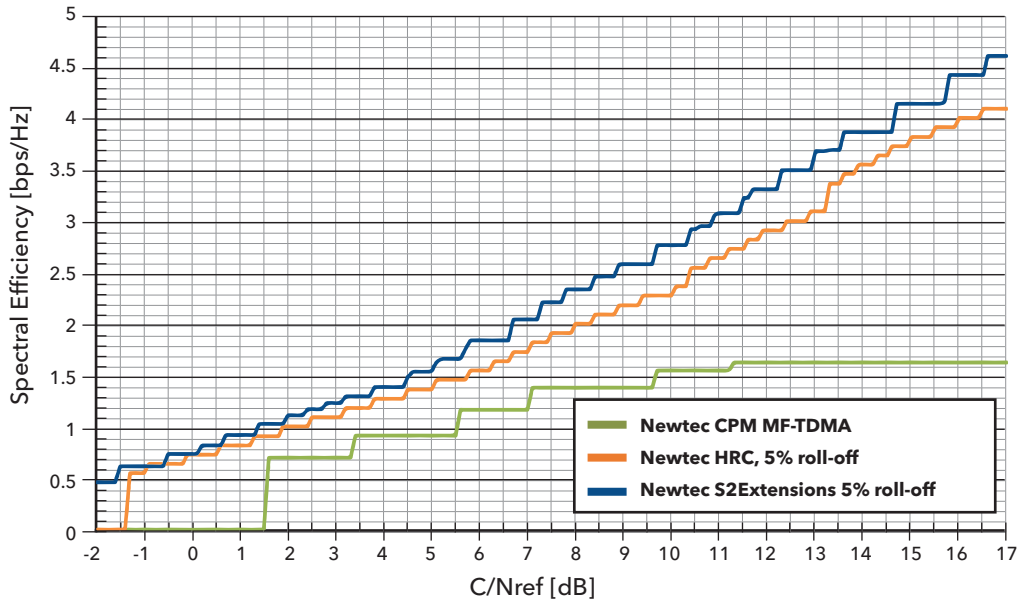


Figure 1: Comparison efficiency of 3 optional return link technologies (MF-TDMA, SCPC and Mx-DMA)

Where are the main gains in Newtec Mx-DMA coming from?

- The chart in Figure 1 clearly indicates that the spectral effciency of Mx-DMA HRC (orange line) is much higher than the MF-TDMA return technology (green line) which suffers from synchronization overhead and burst guard times.
- Within the Mx-DMA return link each carrier is assigned to only one terminal. As such, SCPC-like return efficiencies can easily be achieved.
- At the same time the flexibility of MF-TDMA can be maintained. It remains possible in Mx-DMA to allocate bandwidth on demand and in real-time.
- Mx-DMA fully supports statistical multiplexing 'in the sky' over the aggregated capacity whilst still respecting SLA agreements.

So how does the Newtec Mx-DMA return technology actually work? As in the case with SCPC, each terminal has its own dedicated carrier, but the huge bandwidth savings resides in the fact that Mx-DMA adjusts the frequency plan, the symbol rate, the modulation, coding and power in real-time of each and every carrier in the satellite network. These adjustments are based on the following parameters:

- Return traffic demand
- Network QoS management
- Channel conditions for the individual terminals in the network

How Much Bandwidth can Newtec Dialog Help You Save?

The true answer to this question lies in the knowledge of your particular network details. Although the savings are by default substantial, whether it is more than 40% or more than 20% depends on a number of variables. That's why we rather present the concrete savings based on two very representative examples: Two use-cases based on a star topology satellite network of 20 terminals, spread over Sub-Saharan Africa (see Figure 2). In the example we will mainly focus on the return channel technologies SCPC, MF-TDMA and Newtec Mx-DMA.

In the table below we have listed the different satellite network parameters for the use cases on the next pages:

Mx-DMA Use Case Link Budget Parameters

- Satellite location: -7.5°E
- Transponder: 36 MHz Ku-band
- EIRP: 45 dBW
- G/T: 1 dB/K
- MF-TDMA Terminal: 1.8 m antenna, 4W BUC
- SCPC Terminal: 1.8 m antenna, 8W BUC
- Hub: 4.9 m antenna in Geneva
- Rain model: ITU-R P.618-10
- System margin: 1 dB
- Link availability: 99.8%

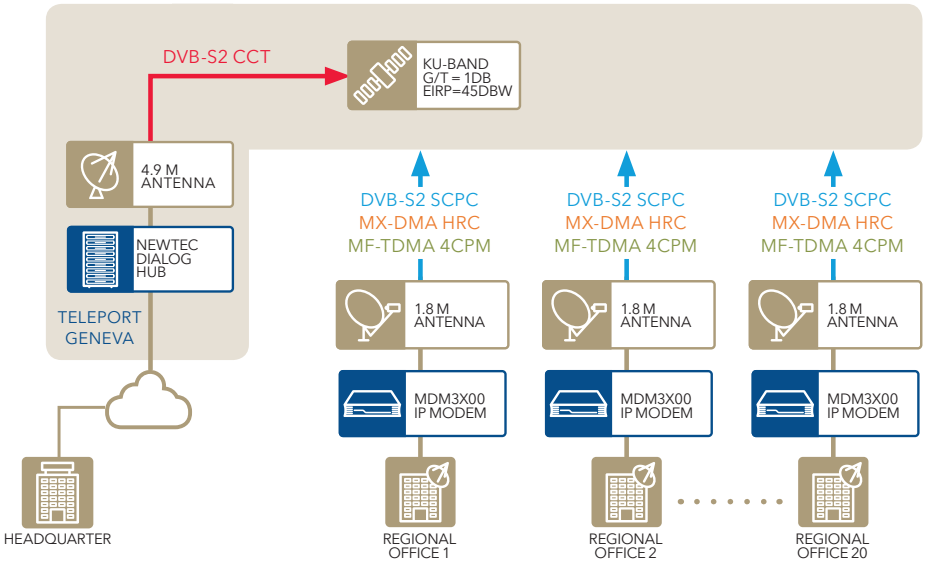


Figure 2: Example satellite network with Newtec Dialog HUB6501 1IF Hub Module and Newtec MDM3x00 modems

CASE 1:
Leased Line Services in Ku-band

In the first case the satellite service provider runs **leased line** services for its customer. In the service level agreement between both companies a dedicated throughput per site at **99.8% availability in Ku-band** has been determined. SCPC is traditionally selected as the most optimal technology for leased line types of networks. But how does it perform against the Newtec Mx-DMA technology when we consider the return channels?

When implementing 20 separate return channels using DVB-S2 technology with a 20% roll-off factor and short frames, the total occupied bandwidth for 18 Mbps throughput equals 12.44 MHz. To achieve the dedicated service levels for SCPC, DVB-S2 is required to have terminals based on a 1.8 m antenna and 8W BUC. For the same 18 Mbps of dedicated throughput over the leased lines, Newtec Mx-DMA only requires 8.06 MHz satellite bandwidth. In other words, by deploying Newtec Dialog and the **Newtec Mx-DMA return technology, 35% savings** can immediately be generated for this leased line network.

We can even take the efficiency gains a step further by engaging the full potential of Newtec's Mx-DMA technology. In the above sizing, each of the 20 sites gets the dedicated return throughput according to its service profile, resulting in the total aggregate capacity of 18Mbps in the return link. However, it is very unlikely all 20 sites are instantaneously using the full service profile dedicated capacity. Consequently, operators can apply a **statistical multiplexing gain** on the aggregated capacity compared to the sum of the individual links (which is also common practice in terrestrial networks). The statistical multiplexing will not burden the end-user experience or the service level agreements. Newtec Mx-DMA technology and its on-demand bandwidth allocation fully supports the "statistical multiplexing in the sky" feature.

For this leased line network a conservative 25% statistical multiplexing gain has been considered for the 20 sites, reducing the throughput from 18 to 13.5 Mbps.

By implementing statistical multiplexing together with Newtec Mx-DMA technology, the satellite service providers can realize a **52% bandwidth saving**, compared to DVB-S2, going from 12.44 MHz to 6.02 MHz satellite bandwidth.

Sites	Fixed bitrate Service Profile
4 sites	2 Mbps dedicated
4 sites	1 Mbps dedicated
12 sites	512 kbps dedicated

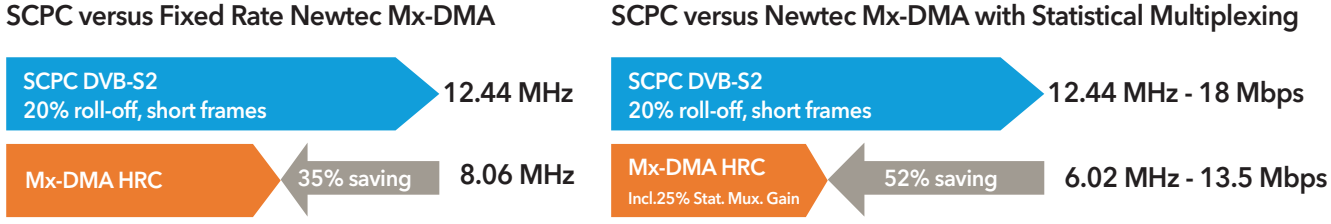


Figure 3: Comparison performance Newtec Mx-DMA (with and without statistical multiplexing) and SCPC

CASE 2:
Shared Services in Ku-band

In the second case the service provider offers shared and overbooked services in the return link over satellite for the 20 remote sites. The SLA provides 2 Mbps peak rate (PIR) for all remotes and three types of committed information rates (CIR) for the satellite network over a Ku-band transponder at 99.8% availability. Traditionally MF-TDMA would be the selected technology to handle these types of traffic. In this scenario we will compare the MF-TDMA performance against Newtec's Mx-DMA.

When selecting MF-TDMA as the technology for the return link for the 20 remote sites running shared and overbooked services, a total satellite bandwidth of 7.76 MHz would need to be allocated. In this MF-TDMA network a 1.8 m antenna and 4W BUC are put into operation.

Alternatively Newtec's Mx-DMA only requires 3.89 MHz to run the same throughput for the same PIR and CIR services. As such Mx-DMA, running on the Newtec Dialog platform, results in a **50% gain** compared to MF-TDMA technology.

CASE 3:
More Throughput, More Customers per MHz

Both use cases clearly demonstrate the Newtec Mx-DMA benefits over SCPC and MF-TDMA as return technology. For dedicated capacity services, Mx-DMA HRC typically brings two equally attractive options when compared to SCPC: Save more than **35%** bandwidth or serve **54%** more customers within the same bandwidth. By applying statistical multiplexing together with Mx-DMA the bandwidth gain will be increased to **52%**.

For shared and overbooked services, the bandwidth saving of Mx-DMA HRC is even more than **50%**, equivalent to serving more than double the number of customers in the same bandwidth.

Note that the physical spectral efficiency is further increased thanks to the Acceleration & Compression technology which is embedded in the Newtec Dialog system. The combination of several header and payload compression, multiplexing and packet reduction methods results in an additional increase of return link efficiency of 20 to 35%, independent of the underlying return link technology (4CPM, SCPC, MX-DMA).

Sites	Shared Service Profile
4 sites	2 Mbps PIR – 1Mbps CIR
4 sites	2 Mbps PIR – 512 kbps CIR
12 sites	2 Mbps PIR – 256 kbps CIR

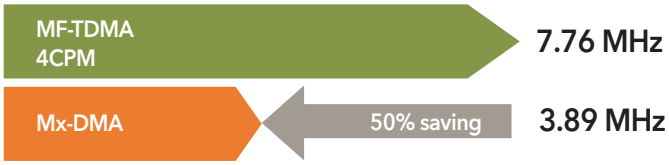


Figure 4: Comparison performance Newtec Mx-DMA and MF-TDMA

Mx-DMA for Fixed Bitrate Services

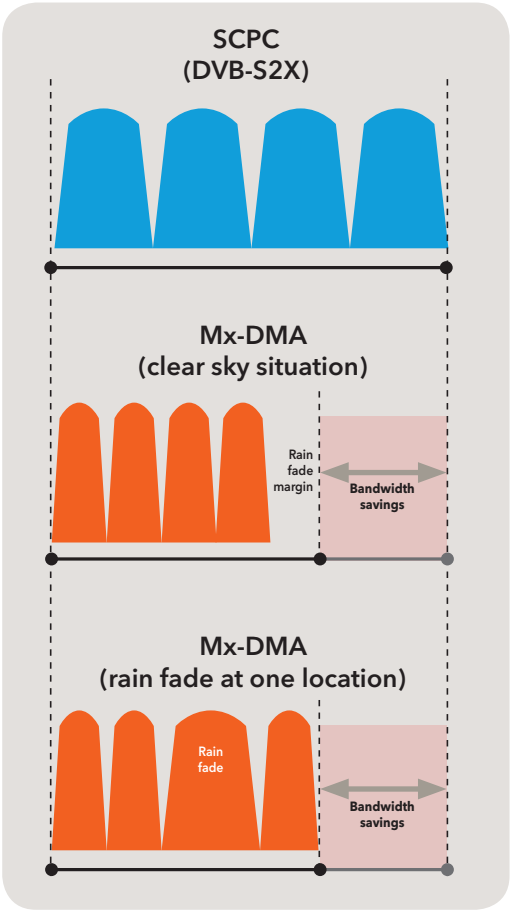
Traditional setup

For contribution of services at fixed bit rate, traditional SCPC can be used. In this case, a rain margin is taken into account for such SCPC carrier. As long as rain fades are within the calculated rain margin, the fixed bit rate is assured even during rain. However, in case of exceptional rain fades beyond the rain margin, the link is lost. As a conclusion: with traditional SCPC, fixed bit rate can be defined, but most of the bandwidth is spoiled „waiting for the rain to happen".

As an alternative, ACM could be used. Since there is no longer a rain margin per carrier, a lot of bandwidth is saved. However, the modulation and coding is dropped during rain fades and hence the bit rate is no longer fixed.

Mx-DMA at work

This is where Mx-DMA can step in, saving bandwidth while still ensuring a fixed bit rate. With Mx-DMA, only one rain margin for the complete network is required. In case of rain, simply the baud rate of the carrier where it rains is increased, while dynamically the center frequency of the other carriers is moved, maintaining fixed bit rate for all carriers. This saves a lot of of bandwidth. The more sites on the same transponder, the bigger the saving becomes.



Conclusion

The Newtec Dialog platform is a scalable and flexible multiservice satellite communications platform that allows satellite service providers to build and adapt their network easily as their business grows.

Newtec Dialog will secure the future of operators, giving them the power to offer a variety of services while making hassle-free decisions on which technology to use. The Newtec Dialog platform provides the scalability, flexibility and efficiency required to run successful operations over satellite.

Efficiency is defined both at operational and technology level in the Newtec Dialog platform. Satellite service providers can select the best transmission technology for their particular application, service or traffic type.

For the return satellite link the service provider has the option between SCPC, MF-TDA, or the best of both worlds: Newtec's patented Mx-DMA.

Newtec Mx-DMA combines the best qualities of SCPC and MF-TDMA and solves the difficult choice of selecting one or the other. Compared to SCPC, 35% bandwidth can be saved or used to increase the quality of the content for dedicated capacity services. Alternatively 54% more customers can be added to the network.

For shared and overbooked services the bandwidth savings for Mx-DMA are more than 50%, equivalent to serving more than twice as many customers in the same bandwidth.

Finally, for the fixed bit rate services, Mx-DMA can garantuee high service availability with hardly any rain fade margin.

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SHAPING THE FUTURE OF SATELLITE COMMUNICATIONS

More information:

Send a mail to: **sales@newtec.eu**

Visit our website: **www.newtec.eu**

Contact us: **Newtec Cy N.V.**
Laarstraat 5
B-9100 Sint-Niklaas
Belgium
Tel: +32 (0)3 780 65 00
Fax: +32 (0)3 780 65 49

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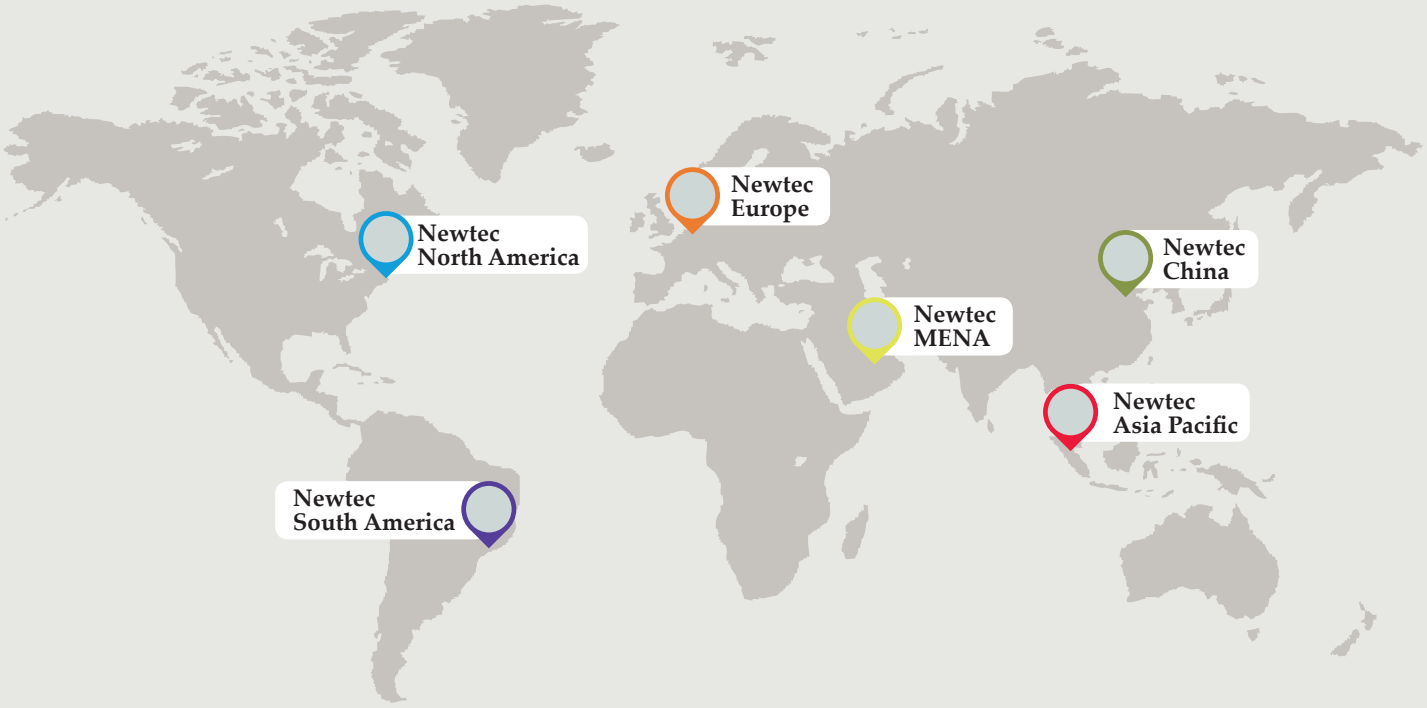

Europe	North-America	South-America	Asia-Pacific	China	MENA
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Fax: +32 3 780 65 49	Fax: +1 203 323-8406	Fax: +55 11 2093 3756	Fax: +65 6777 08 87	Fax: +86 10-823 18 731	Fax: +971 4 368 67 68