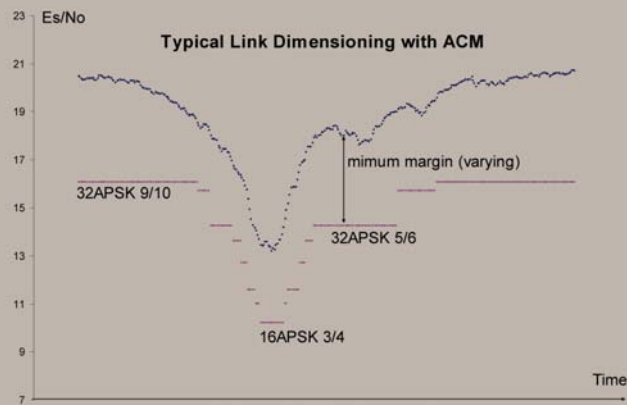
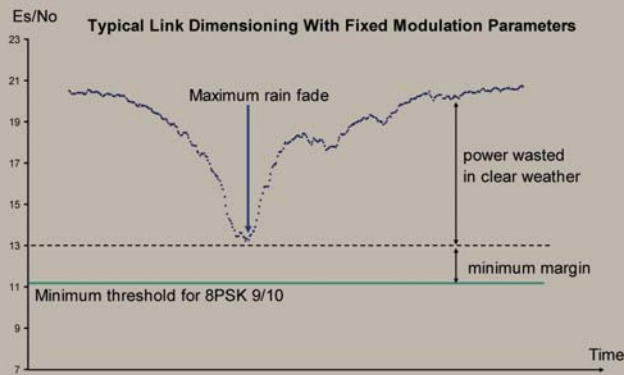


Adaptive Coding and Modulation (ACM) for IP Backbone and IP Trunking Systems



Link budget Considerations

When dimensioning a satellite link, one has to take into account the average and extreme climatic conditions at the transmission sites and the acceptable probability of losing the signal due to rain fade. The transmission power and the level of error correction overhead are selected accordingly, so that the signal-to noise-ratio remains above the minimum threshold that guarantees an error-free transmission for a time defined by the target availability of the link budget. This means that most of the time, when the weather is clear or fair, the signal to noise-ratio is well above the minimum threshold. During this period, the additional margin corresponds to a significant portion of the available data throughput that is wasted with unnecessary error correction overhead.

Why ACM?

ACM allows modification of the modulation parameters of a satellite signal on the fly, without interrupting the transmission and without losing data. When combined with a measurement of the instantaneous link conditions every few seconds and a system that automatically adjusts the modulation parameters when needed, ACM allows using the highest possible modulation scheme and the lowest possible level of error correction at all times. In some instances the amount of data that can be transmitted in a given satellite segment can be doubled (on average) compared to a fixed modulation system. When the condition of the link gets worse because of rain fade, the system will automatically change the parameters to avoid loss of signal reception.

An ACM system therefore provides two major benefits:

- It always maximizes the throughput of a satellite link, doubling the capacity in average.
- It guarantees 100 percent availability of the link reception.

The combination of these advantages is particularly useful for IP transmission, where higher throughput is always welcome and where users never want to lose their connection.

Why FlexACM?

FlexACM, is a solution that makes the implementation of ACM in IP trunking and IP backbone systems not only straightforward but also very efficient. It consists in four new options and one additional piece of equipment in the Elevation product family. It enables ACM in point-to-point and point-to-multipoint systems, for one way as well as two way configurations.

A combination of several factors makes FlexACM a unique ACM solution on the market:

- Very accurate estimation of the link condition with Newtec's patent pending NoDE Noise and Distortion Estimator.
- Support of all DVB-S2 Modulation and coding schemes, including 32APSK
- In-band communication between the receiver and the transmitter
- Optimization with traffic enhancement products such as the Performance Enhancement Proxy server and clients EL840, EL830 and EL820.
- Exceptional level of integration and ease of use

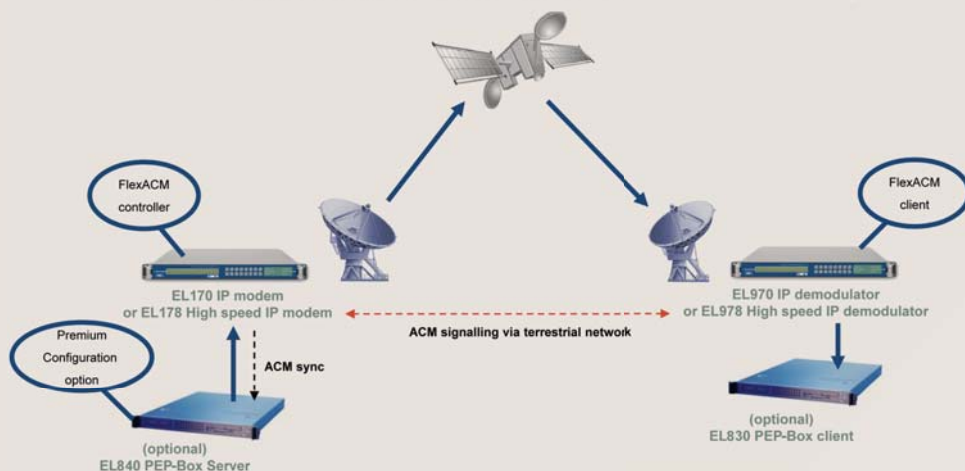
Implementation Examples

Point-to-Point, One Way

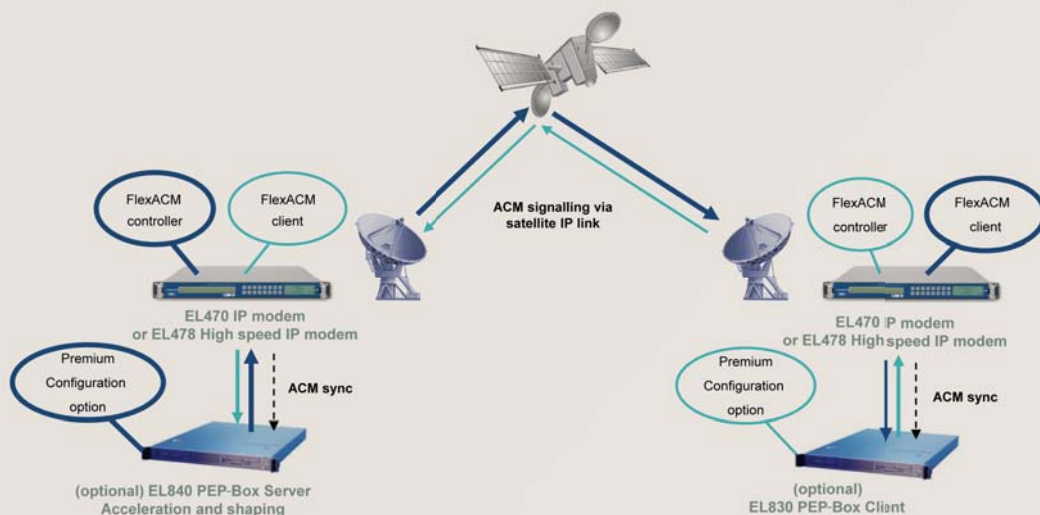
For point-to-point applications, the FlexACM solution is particularly simple. It consists of a FlexACM controller option to be enabled on the Elevation modulator EL170 (or EL178 for higher speeds) and a FlexACM client option to be enabled on the IP demodulator EL970 (or EL978). The FlexACM controller automatically communicates with the FlexACM client on the other end of the transmission chain via a terrestrial IP connection, such as the Internet. The modulator contains all the necessary logic to dynamically optimize the modulation parameters whilst throttling the IP traffic accordingly.

Optionally, a PEP-Box Server EL840 can be installed in front of the modulator in order to shape and accelerate the traffic. The Premium configuration option of the EL840 ensures "Zero-Packet-Loss" congestion avoidance between the dynamic processes taking place in the EL840 and the dynamic behavior of the ACM link. For traffic acceleration, the EL840 work in conjunction with the PEP-Box client EL830 at the receive end.

FlexACM Point-to-Point, One Way



FlexACM Point-to-Point, Two Way



Point-to-point, Two Way

If modems are installed at both ends of the satellite link, ACM can be implemented in both directions. A combined FlexACM controller and client is available on the Elevation modem EL470 (or EL478 for higher speeds). The communication between the two modems can be in-band, making the operation of the system particularly simple: all the functionalities are integrated in the modems and the modems talk to each other in order to automatically configure themselves so there is no need for link budgets or transmission tests.

Optionally a PEP-Box server EL840 and client EL830 can be installed at both end of the transmission link in order to shape and accelerate the traffic. The Premium configuration option need to be activated on both ends to ensure shaping, optimization and synchronization with the ACM system.

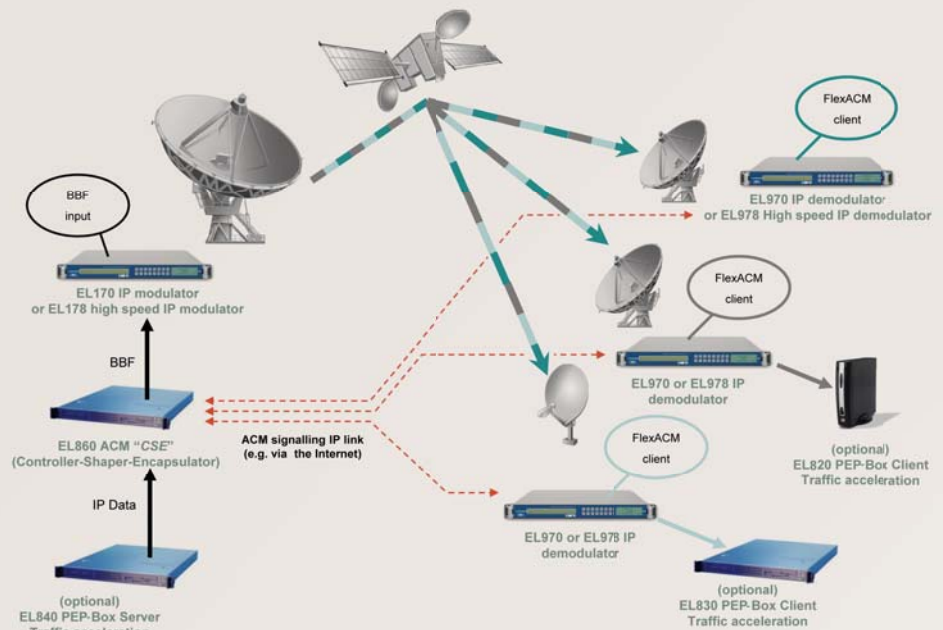
Point-to-multipoint, One Way

In point-to-multipoint systems, the IP traffic is distributed to several receiving points on a single satellite carrier. Each receiving point provides feedback on the local reception condition, and the FlexACM system at the uplink will automatically and dynamically select modulation parameters for each IP packet, depending on the destination of this packet. If one of the receiving points is affected by rain fade, the traffic for that point will use more bandwidth resulting in a reduction of the total available throughput on the forward link. The system must then decide how the remaining capacity is distributed among the services and receiving points. This requires a dynamic shaping of the IP services and a QoS management in line with the bandwidth variations caused by the ACM behavior. For these reasons, the FlexACM controller, the IP encapsulation and the traffic shaping function have been combined in a single product: the EL860 ACM Controller, Shaper and Encapsulator (CSE). The outputs of the EL860 are DVB-S2 frames that are ready to be modulated. These frames are called Base-Band Frames and are carried on an Ethernet interface. The EL860 is therefore to be used together with a DVB-S2 modulator EL170 (or EL178) equipped with a Base-Band Frame input option.

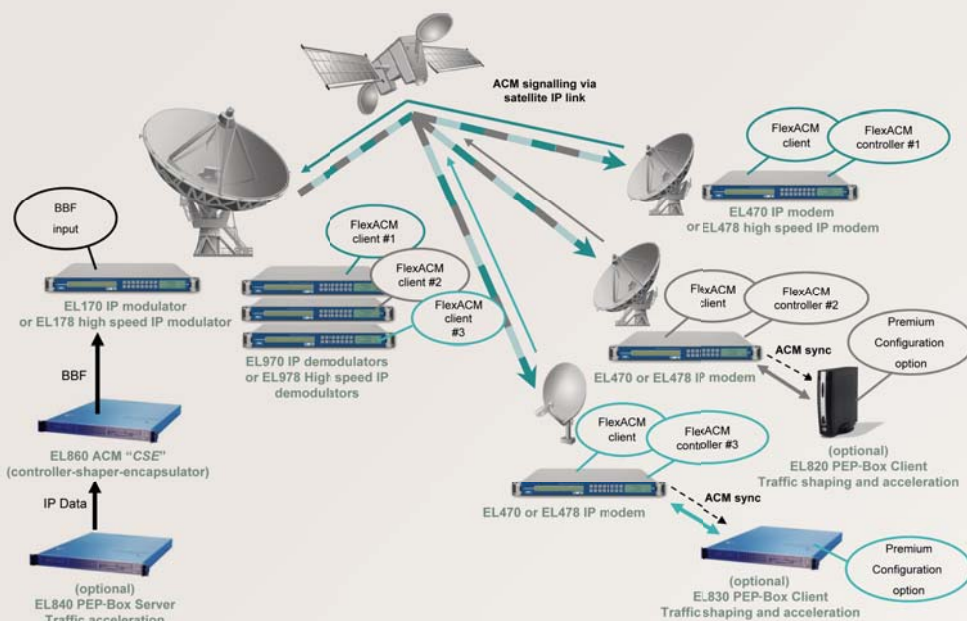
The remote sites of the network are implemented with IP demodulators EL970 (or EL978) equipped with the FlexACM client option. The FlexACM clients communicate with the EL860 via a terrestrial network

Additional traffic acceleration and enhancement can be provided by installing a PEP-BOX server EL840 in front of the EL860 and a PEP-BOX client EL820 or EL830 in the remote sites.

FlexACM, Point-to-Multipoint, One way



FlexACM, Point-to-Multipoint, Two way



Point-to-multipoint, Two Way

For an ACM implementation from the hub to the remote sites as well as from the remote sites to the hub, Elevation modems EL470 or EL478 need to be installed in each of the remote sites. Each modem must be equipped with the FlexACM controller and client. The configuration of the hub is similar to the one way system, but a series of Elevation demodulators EL970 or EL978 are added in order to receive the signals from the remote sites. Each demodulator is equipped with a FlexACM client in order to provide feedback to the corresponding modem. The communication between the FlexACM controllers, the FlexACM clients and the EL860 can be completely in-band.

Traffic acceleration and enhancement can be added by installing an EL840 in the hub. For traffic shaping in the return channel, a PEP-box client EL820 or EL830 with Premium configuration option needs to be installed in each of the remote sites.



Reference Case and Customer Testimonial

Major Increase in Efficiency and Reliability for CobraNet IP Trunking Link

Nigeria-based CobraNet is a leading provider of broadband internet services. Since 2003, it has provided the Nigerian Market with a highly reliable Internet service and now plans further expansions in this region and into West Africa in the near future.

In order to continue its pattern of growth, CobraNet needed to improve the bandwidth efficiency of its satellite link between the Intelsat Teleport in Fuchsstadt, Germany, and its own in Lagos, Nigeria, and chose Newtec to carry out the upgrade from DVB-S to DVB-S2 modems. Newtec's technology was incorporated into both ends of the link introducing 16APSK and 32APSK capabilities for the modulators and demodulators coupled for the first time with Newtec's Adaptive Coding and Modulation (ACM) FlexACM technology.

The bi-directional link uses 18 MHz of satellite capacity on the forward link towards Nigeria, and 9 MHz on the return. Before the upgrade, the link was implemented with 8PSK signals and the throughput was limited to 38 and 14 Mbps respectively. Following the upgrade, CobraNet tested the link for differences to the efficiency readings and found that after the implementation of Newtec's onboard FlexACM solution, the satellite link gained 70 percent in throughput for an average of 300 days a year and was able to achieve, in clear skies, a forwards efficiency of

65 Mbps with 32APSK and a return efficiency of 32 Mbps with 32APSK. Thanks to FlexACM, the satellite transmission is now also much more robust, guaranteeing 100 percent service availability. The system is indeed able to sustain very heavy rain fades by changing dynamically the modulation parameters and progressively adding more error correction when needed. During rain fades as deep as 20 dB, the modulation parameters are changed gradually to QPSK 2/3 and the data throughput drops momentarily to 20 Mbit/s in the forward, but the system does not lose synchronization. This is the only satellite system in the region to maintain its service in presence of such heavy rain.

"As Nigeria's leading internet provider it is important for us to continue to stay ahead of the competition, especially in terms of our connection speed and technology", said Karim Boulos, Chairman of CobraNet Limited.

"Newtec has given us the chance to experience the significant enhancements of the DVB-S2 standard providing major gains in performance and throughput and with the addition of Newtec's adaptive coding and modulation technology, our customers can be sure that they will receive a stable, flexible and highly reliable connection during all weather conditions," concluded Boulos.



SHAPING THE FUTURE OF SATELLITE COMMUNICATIONS

www.newtec.eu

Europe

Tel: +32 3 780 65 00
Fax: +32 3 780 65 49

North-America

Tel: +1 (203) 323-0042
Fax: +1 (203) 323-8406

South-America

Tel: +55 (11) 2092 6220
Fax: +55 (11) 2093 3756

Asia-Pacific

Tel: +65 6777 22 08
Fax: +65 6777 08 87

China

Tel: +86 10-823 18 730
Fax: +86 10-823 18 731

MENA

Tel: +971 4 390 18 78
Fax: +971 4 368 67 68

Africa

Tel: +27 11 640 2745
mbr@newtec.eu