

**A Powerful Combination:**

**Integrating Group QoS & DVB-S2/ACM**

**September 2009**

*Advancing a Connected World*



## Introduction

iDirect's Group Quality of Service (GQoS) provides a comprehensive set of powerful, state-of-the-art features that allow Service Providers a significant increase in bandwidth management capabilities. This is especially important when prioritizing traffic for customers in a shared network environment - resulting in greater flexibility for traffic configuration and prioritization, more bandwidth savings and improved service quality for customers. GQoS creates new sales opportunities for Service Providers where service plans can be matched to their customers' unique and growing bandwidth needs and ensure service quality for different applications as the networks expand.

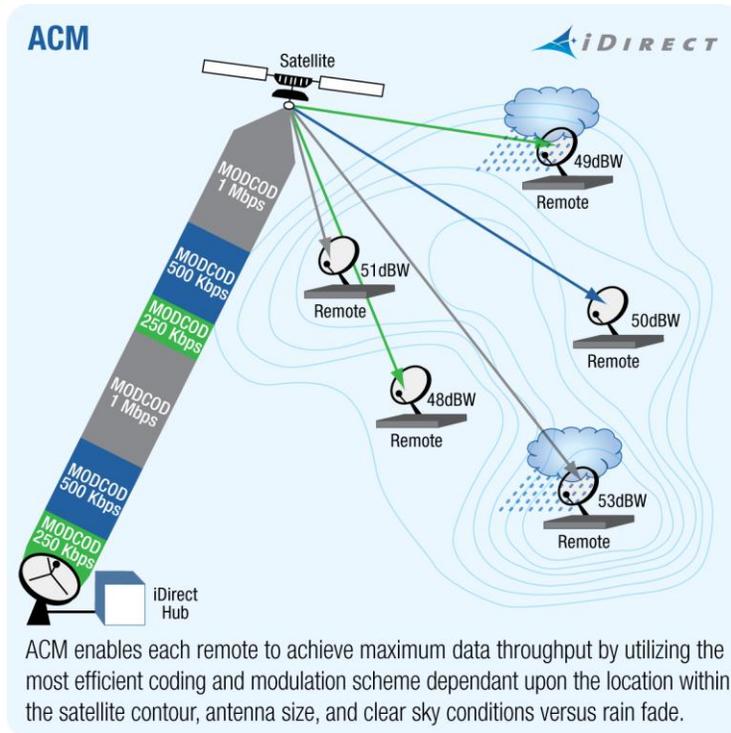
DVB-S2/ACM is also creating new opportunities for Service Providers. They can take advantage of the most efficient transmission scheme, DVB-S2, by combining multiple small networks into a single, larger carrier, bringing additional advantages to network design. Coupled with Adaptive Coding and Modulation (ACM), each remote can operate at its most efficient modulation and coding (MODCOD) scheme, at any moment in time, depending on location within the satellite contour, antenna size, and atmospheric conditions. ACM evaluates current channel conditions and throughput requirements through a return channel to determine the ideal modulation and FEC rate for each individual remote and makes adjustments in real time. In short, ACM not only optimizes the bandwidth efficiency for maximum throughput on a remote-by-remote basis, but Service Providers avoid having to determine in advance which modulation and coding should be used.

With adaptive MODCODs comes the challenge of accurately delivering and pricing the different service levels that end-customers come to expect. Traditional pricing models no longer apply as bandwidth requirements vary significantly with adaptive MODCODs. This paper will briefly examine the challenges of traditional bandwidth allocation and demonstrate the benefit of a tight ACM and GQoS integration.

## Traditional Pricing Models

Service Level Agreements (SLAs) are based on Committed Information Rate (CIR) and percent availability (uptime) while the service price is based on satellite bandwidth. CIR is the amount of dedicated bandwidth assigned to a particular router to eliminate the need to contend for an opportunity to transmit regardless of how busy the network is. The bandwidth needed to meet the CIR varies significantly based on the MODCOD used, which varies based on rain fade and each terminal.

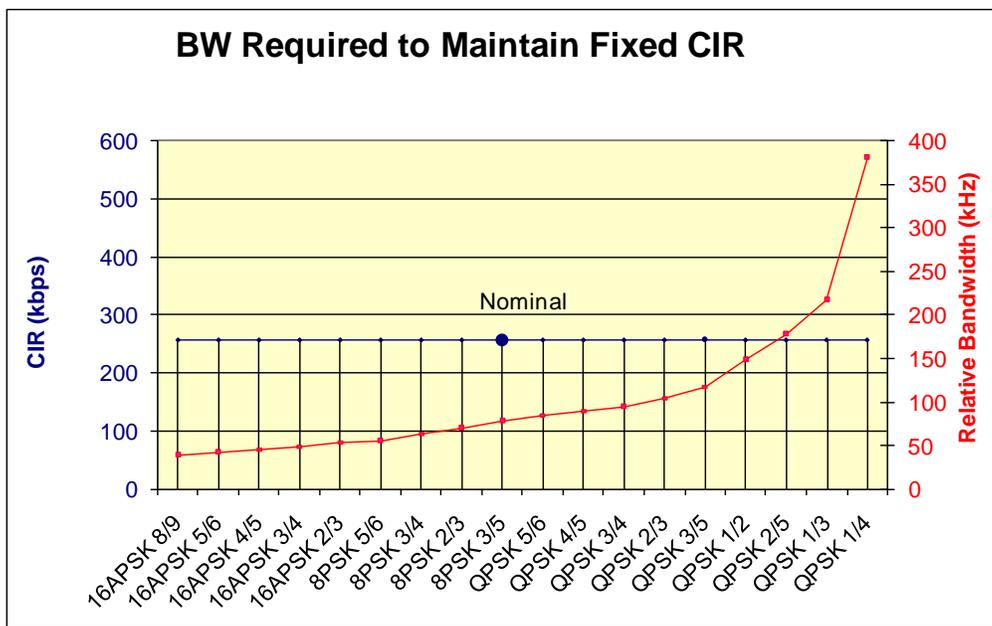
Service pricing prior to DVB-S2/ACM was based on the amount of satellite bandwidth needed to achieve a CIR designed around a reliable MODCOD operating in worst case conditions such as heavy rain fade. The satellite bandwidth price per remote was known since a fixed MODCOD was used throughout the network. However with DVB-S2/ACM, adaptive MODCODs vary constantly based on weather conditions, so the required bandwidth to provide a given CIR varies constantly as well.



**Figure 1. Adaptive Coding and Modulation**

With DVB-S2 in ACM mode, the same amount of user data occupies less or more bandwidth, depending on the MODCOD at which it is transmitted. For example, user data transmitted at a higher MODCOD requires less bandwidth than it does at a lower MODCOD to guarantee a fixed CIR.

Figure 2 shows the relative bandwidth required to deliver a fixed CIR across MODCODs.



**Figure 2. DVB-S2/ACM's Varying Bandwidth Requirements Across MODCODs**

### *Example*

A remote location requires a fixed CIR of 256 Kbps. The nominal MODCOD is set at 8PSK 3/5 at Clear Sky. With adverse weather conditions the MODCODs change and more bandwidth now is required to maintain the fixed CIR of 256 Kbps.

	<b>MODCOD</b>
Clear Sky	8PSK 3/5
Rain Fade	QPSK 3/5, requiring 50% more bandwidth
Heavy Rain Fade	QPSK 1/4, requiring almost 5 times more bandwidth

In this example, maintaining the same CIR at heavy rain fade requires almost five times the Clear Sky bandwidth.

It would be unfair to charge two remotes the same service price if they are operating at different MODCODs where one remote may be consuming five times the bandwidth compared to the other while still getting the same CIR. Even without ACM, Service Providers were not able to treat customers with varying remote antenna sizes fairly. Networks were traditionally designed around worst-case parameters, in this case the smallest antenna to account for the total needed bandwidth. Customers who invested in larger antennas were not rewarded for utilizing less bandwidth compared to those with smaller antennas.

By tightly integrating GQoS and DVB-S2/ACM these challenges can be overcome and customers can be treated more fairly.

### **New Configuration Parameters**

With the tight integration of ACM and GQoS comes the benefit of introducing new configuration parameters and options that were previously not easy to configure, operate or monitor.

#### **Nominal MODCOD Configuration**

The Nominal operating point represents the MODCOD that the Service Provider bases the SLA on to provide a CIR with a given availability to a customer.

In a network with fixed remotes, the Service Provider can configure the Nominal operating point to be the Clear sky operating point based on the link budget or could set it at a MODCOD lower than Clear sky to improve the CIR availability. In a mobile network, the Nominal operating point can be any point in the beam coverage at which the Service Provider wants to guarantee a CIR and a given availability.

iDirect's iVantage NMS provides statistics on the operating point of each remote. The Service Provider can use these statistics to determine the percentage of time a remote is operating at its Nominal MODCOD and at other MODCODs. Although independent of traffic, this allows Service Providers to compare a remote's actual operating point with its configured (or contractual) operating point and make adjustments in the case of discrepancies.

The configuration of a Nominal operating point allows the Service Provider to offer two new service offerings in a DVB-S2/ACM network:

- Fixed bandwidth
- Fixed CIR / Extended Information Rate (EIR)

**Fixed Bandwidth Configuration**

In this configuration the Service Provider can base the pricing on the Nominal MODCOD and corresponding satellite bandwidth used at an agreed upon Nominal operating point. The CIR and Maximum Information Rate (MaxIR) are limited to this configured point.

When the remote goes into rain fade and the MODCODs change to a more conservative setting, the CIR and MaxIR are scaled down relative to their configured Nominal operating points. This provides a gradual degradation in CIR/MaxIR during rain fade while consuming a fixed satellite bandwidth based on the amounts consumed during the Nominal operating point.

During Clear Sky the remote is allowed to operate at MODCODs higher than its Nominal operating point but will not be rewarded with a higher CIR/MaxIR.

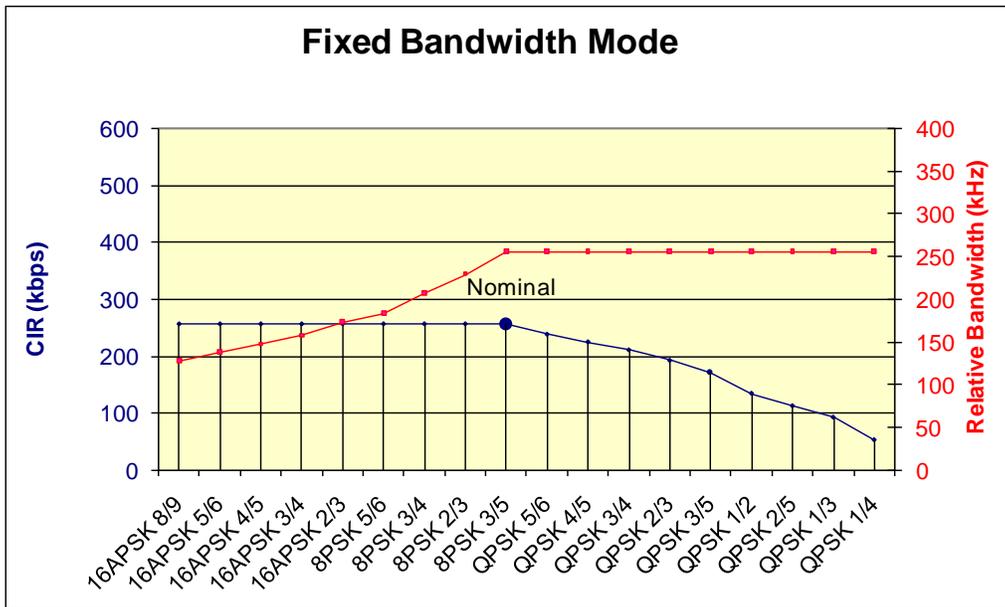


Figure 3. Total Bandwidth vs. Information Rate in Fixed Bandwidth Operation

**Fixed Bandwidth Benefits**

- The Service Provider benefits from the savings in bandwidth during clear sky conditions while complying with the Service Level Agreement (SLA) of its customers. The Service Provider has the option to configure the Nominal operating point at Clear Sky or at a lower point to improve the availability of the CIR in a light rain fade.
- The end-user benefit comes from a fair pricing model by the Service Provider. End-users investing in larger antennas would be able to take advantage of lower service pricing if their

operating point is at the higher efficiency MODCODs. Also the end-user has the option of experiencing a more gentle degradation in CIR during rain fade for a more affordable service pricing instead of signing up for a guaranteed CIR at severe rain fade.

**Fixed CIR/ EIR Configuration**

For customers who need a fixed CIR under changing MODCODs and bandwidth conditions, Service Providers can now offer an Extended Information Rate (EIR) option, also referred to as rain fade insurance. EIR can be offered as a way to maintain CIR during rain fade of a particular remote or a critical application such as VoIP.

The configured EIR Minimum determines the lowest MODCOD that will honor the CIR during rain fade. When operating at or above the EIR Minimum, the system always attempts to allocate requested bandwidth in accordance with the CIR and MaxIR settings, regardless of the current MODCOD at which the remote is operating. The customer will be guaranteed the CIR during rain fade down to the EIR Minimum.

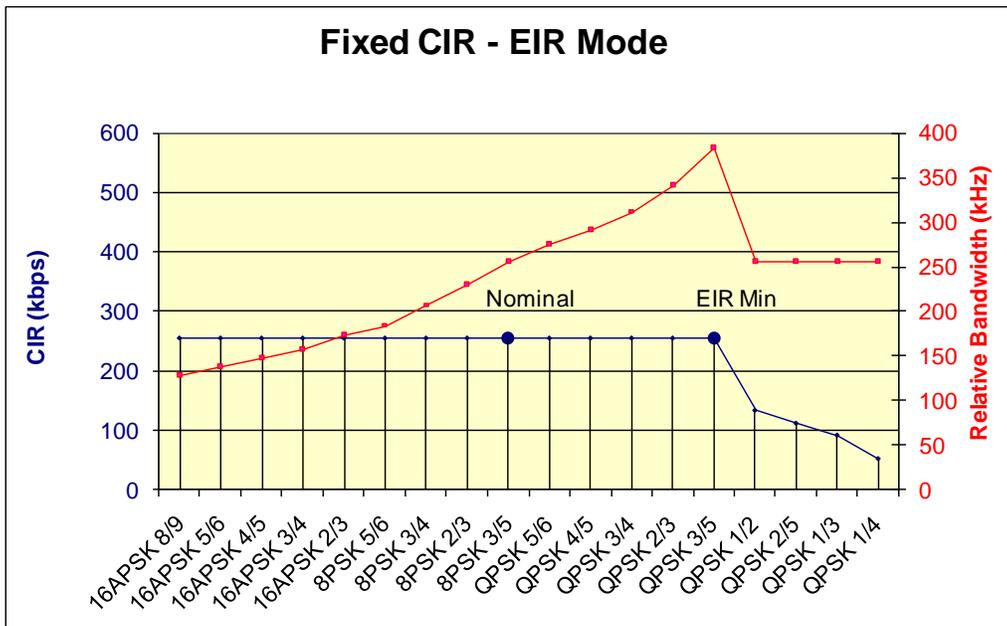


Figure 4. EIR: Total Bandwidth vs. Information Rate as MODCOD Varies

*Example*

In Figure 4, the Nominal MODCOD is configured at 8PSK 3/5 based on the expected Clear Sky operating point for the remote. The system will maintain the CIR for the remote during rain fade down to the configured EIR Min at QPSK 3/5. Note the additional bandwidth required to maintain the CIR in rain fade. If the remote goes into a deeper rain fade resulting in operation below the EIR Min, its CIR will be scaled down relative to the satellite bandwidth required at its Nominal MODCOD.

### Fixed CIR/ EIR Benefits

- The Service Provider can benefit from this option by offering a “rain fade Insurance” option for customers desiring to maintain their CIR during rain fade and willing to pay for it. The pricing of this option can be based on how much rain fade margin the end-user requires which determines the EIR Minimum. Services can be charged a premium since more bandwidth is needed during rain fade.
- End-users can benefit from having higher availability of CIR during rain fade for their business critical applications or locations. The EIR option let Service Providers offer a fair pricing model to end-users.

### Bandwidth Allocation Fairness in Contention

With the tight integration of GQoS and ACM comes the possibility for Service Providers to offer additional fairness in bandwidth allocation during times of contention to their customers. It gives the Service Provider the flexibility to maximize the performance of a network in a fair and flexible manner. There are two options the Service Provider can choose to implement:

- Allocation Fairness Relative to CIR
- Allocation Fairness Relative to MODCOD

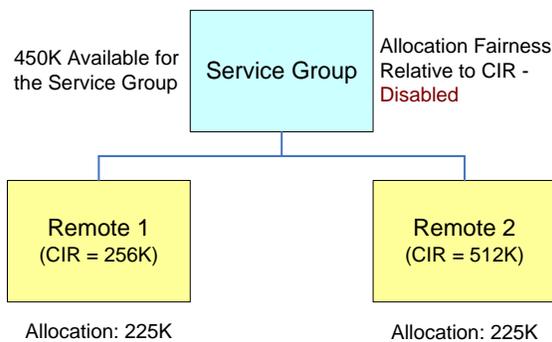
#### Allocation Fairness Relative to CIR

This configuration option allows the allocation of the available bandwidth during contention relative to the configured CIR of each customer. The same fairness scheme applies to the bursting round of bandwidth allocation when all CIRs are satisfied.

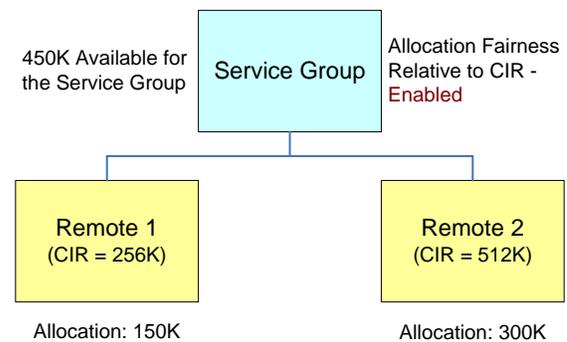
#### Example

Remote 1                      CIR: 256 kbps  
Remote 2                      CIR: 512 kbps  
(Both Remotes operating at the same Nominal MODCOD)

#### Scenario A



#### Scenario B



In scenario A, Remote 1 and Remote 2 both operate at the same Nominal MODCOD. Remote 1 is configured with a CIR or 256 Kbps while Remote 2 is configured with a CIR of 512 Kbps. The Service

Provider may choose to split the total available bandwidth of 450K equally during contention until the lower CIR is satisfied which results in both Remotes 1 and Remote 2 getting a bandwidth allocation of 225 Kbps.

In scenario B, the Service Provider allocates the bandwidth proportionally to the remote's CIR. In this case Remote 1 gets half of the bandwidth of Remote 2.

While some corporate networks may want to satisfy remote sites with small CIRs during contention like in scenario A, Service Providers generally would increase the customer's satisfaction by allocating the bandwidth more fairly relative to the contracted CIR like in scenario B.

### Allocation Fairness Relative to MODCOD

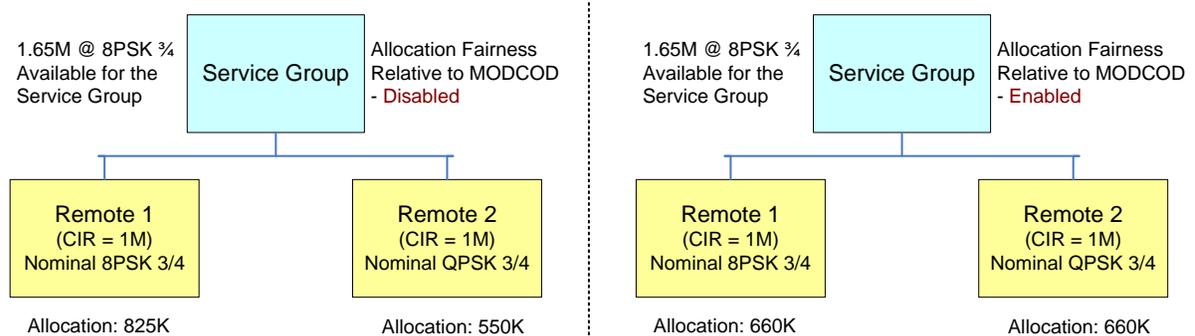
This configuration option allows the allocation of the available bandwidth during contention in a way that provides equal information rates to remotes configured with the same CIR regardless of their configured Nominal MODCOD. The same fairness scheme applies to the bursting round of bandwidth allocation when all CIRs are satisfied.

#### Example

Remote 1	8PSK 3/4 Nominal MODCOD, CIR: 1 Mbps
Remote 2	QPSK 3/4 Nominal MODCOD, CIR: 1 Mbps
	(R2 requires 1.5 times more bandwidth than R1 for same CIR)
Available bandwidth	Equivalent of 1.65 Mbps @ 8PSK 3/4

Scenario A: Split available satellite bandwidth evenly

Scenario B: Split available bandwidth to achieve equal Info Rate



In this example, Remote 1 and Remote 2 are both configured with a CIR or 1 Mbps. Remote 1 is operating at a Nominal MODCOD of 8PSK 3/4 while Remote 2 is operating at a Nominal MODCOD of QPSK 3/4. Note that QPSK 3/4 requires about 1.5 times the bandwidth of 8PSK 3/4 to deliver the same CIR. In scenario A the Service Provider splits the satellite bandwidth equally during contention, which results in Remote 1 getting 825 Kbps and Remote 2 getting 550 Kbps. In scenario B the Service Provider provides the same Information Rate to Remote 1 and Remote 2, 660 Kbps in this case. This results in Remote 2 utilizing 1.5 times the satellite bandwidth of Remote 1.

While some Service Providers for corporate networks may elect to operate in scenario A to favor remotes operating at more efficient MODCODs, Service Providers that encourage end users to invest in larger antennas through their service pricing model prefer scenario B. In such case, the pricing model reflects the additional bandwidth required at lower MODCODs and fairness relative to MODCODs is more appropriate.

These different allocation and configuration options enable the Service Provider for the first time to implement more fairness algorithms and start offering a wider selection of pricing options for the end-customer. This ultimately will result in increased customer satisfaction.

## **Conclusion**

iDirect's full integration of DVB-S2/ACM with GQoS provides maximum efficiency, flexibility and allocation fairness for the Service Provider that results in increased customer satisfaction and more service options for the customers. Service Providers can create a wider selection of service offerings based on their DVB-S2/ACM service that ultimately translates into an increased revenue opportunity and a unique competitive advantage. This is an opportunity that is only made possible through the tight integration of DVB-S2/ACM and GQoS and that cannot be achieved with an external QoS device. These benefits maximize the bandwidth efficiency of a Service Provider's network and enable them to maximize revenue and increase end-customer satisfaction.