

# CONSTELLATION

CREATING RELATIONSHIPS

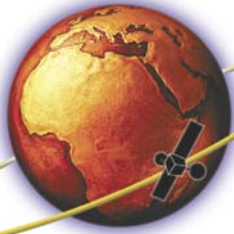
## VoIP over Satellite Using iDirect Technologies Broadband VSAT Network System

iDirect Technologies broadband IP VSAT network system effectively transports VoIP traffic over satellite. The obstacles associated with this challenge have been addressed using iDirect's highly differentiated real time traffic management (RTTM) feature set. The RTTM feature set is an inherent part of iDirect's operating system software (iDS) and has been specifically designed to support applications such as voice that are not tolerant of delay, requiring specific network conditions to perform properly. Traditionally, transporting voice over satellite has been supported through implementation of Single Channel Per Carrier (SCPC) technology ostensibly creating a continuously connected environment similar to a dedicated private line circuit. Using SCPC to support enterprise VoIP needs is bandwidth inefficient and therefore a costly solution. Only iDirect's system delivers "toll quality" digital telephony to the enterprise customer over a highly cost effective shared bandwidth medium employing the following relevant RTTM features:

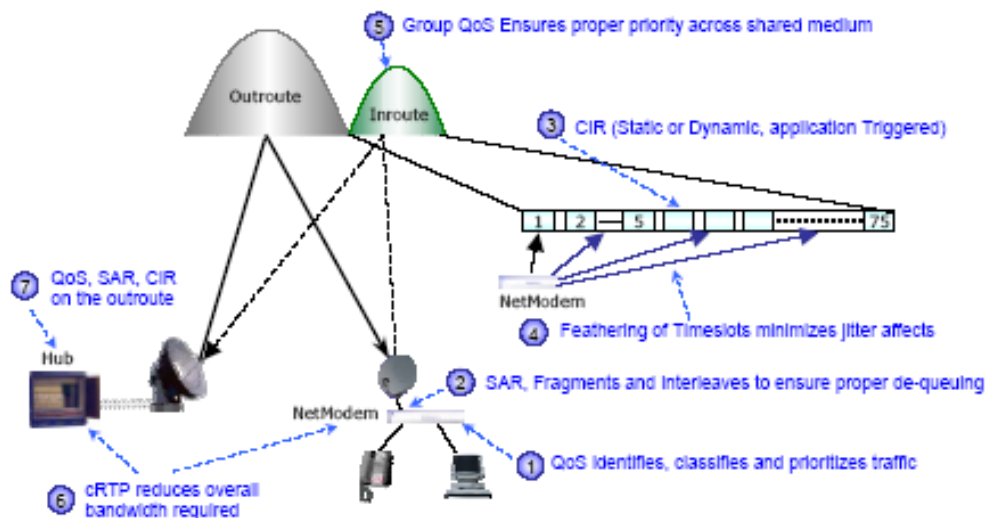
- Application QoS and Prioritization at the NetModem on the TDMA Inroute.
- Segmentation and Reassembly (SAR) at the NetModem, or what is more popularly referred to as Fragmentation and Interleaving.
- Committed Information Rate settings for the NetModem.
- Dynamic CIR and Application Triggered Dynamic CIR.
- Group QoS at the network level.
- Feathering of Timeslot allocation.
- Application QoS and Prioritization at the Hub, on the Outroute.
- SAR at the Hub, on the TDM Outroute.
- CIR at the Hub, on the TDM Outroute.

### Real Time Traffic Management Feature Highlights:

1. **Application QoS** is built into the system enabling realtime identification, classification, and prioritization of data traffic. iDirect's system recognizes different traffic types (See *iTechNote # 8 - iDirect QoS and Prioritization*) and assigns VoIP packets the highest priority within the data transport stream minimizing the impact of data traffic on the voice packets.
2. **Segmentation and Reassembly (SAR)** divides packets of varying sizes into equal sized cells allowing for more effective QoS prioritization handling. For example, if a large FTP packet (1500 bytes) starts transmitting while a VoIP call is simultaneously being setup (80 bytes), iDirect's Application QoS identifies and prioritizes the voice packets that will need to wait while the system completes the transmission of the large FTP packet. If this scenario occurs during a congested network state, invoking QoS alone is not sufficient, as it does not alleviate the resulting delay of the voice packet. However, with the implementation of iDirect's SAR feature, all packets will be broken into equal sized cells capable of being groomed to equal the bandwidth of one timeslot. This ensures that at any instance, a voice packet will not have to wait for more than one timeslot to be transmitted.
3. **Committed Information Rate (CIR) - QoS** at a remote terminal ensures that higher priority traffic is transmitted first, but it does not guarantee that there is sufficient bandwidth at the network level (shared level) to carry the VoIP traffic. In a congested network state (peak hour traffic), if all bandwidth is being dynamically allocated, the fairness algorithm will distribute the bandwidth to all network sites evenly, regardless of traffic volume. Insufficient bandwidth available to transport the voice packets results in jitter and degradation of the voice quality. iDirect overcomes this problem by assigning a CIR to a network site so that the site always has a minimum amount of bandwidth capable of supporting the number of concurrent calls entering the network from that site. QoS at the remote network site ensures that voice packets are transmitted before data packets.
  - **Dynamic CIR** allows the Network Operator to efficiently groom the inroute, enabling CIR to be dynamically controlled.
  - **Application Triggered CIR** is invoked based on the application that requires a CIR. For example, if the QoS rule associated with voice is configured to trigger a CIR. The iDS software will assign the remote network terminal its CIR only when voice traffic is present.



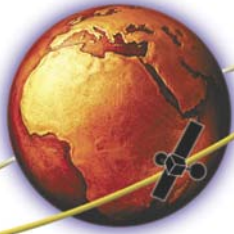
4. **Feathering Timeslot Allocation** – One of the major technical hurdles of implementing VoIP is jitter. When a network system allocates bandwidth to a remote in an effort to support a voice call, if the allocated timeslots are not contiguous the voice packets will arrive at the hub in batches creating an environment conducive to jitter. iDirect's feathering feature significantly reduces jitter between voice packets by evenly spacing timeslots across a frame.
5. **Group QoS** when coupled with CIR provides yet another feature guaranteeing service at the network level. With this feature, one can prioritize real time traffic over non-real time traffic across the shared satellite bandwidth medium. When enabled, the iDS measures the type of traffic that is creating demand at all remote terminals and allocates bandwidth appropriately in an "on-demand" mode to each remote.
6. **Compressed Real Time Protocol (cRTP)** - The iDirect system has built this "header compression" feature into the RTTM feature set reducing the overall bandwidth required to support a VoIP call. An uncompressed VoIP call will occupy about 64 kbps of bandwidth. This coupled with the 16 kbps for the IP headers generates a total bandwidth requirement of 80 kbps per call. To reduce this, the most popular G.729(b) voice compression protocol uses only 24 kbps of bandwidth per call of which 16 kbps of bandwidth is required for the IP header alone. iDirect's addition of cRTP further reduces the bandwidth requirements down to about 12 kbps per voice call achieving a 50% savings in bandwidth.



iDirect Technologies has differentiated itself from other TDM/TDMA VSAT network solution providers that struggle to address the following challenges associated with providing toll quality enterprise class VoIP:

- Performance stressed TDMA channel access protocol used (e.g., Slotted-Aloha).
- Very slow CIR setup (CIR throttling).
- Inferior QoS implementation.
- No SAR capability.
- Jitter handling over a dynamically allocated system.
- No QoS at the shared network level.
- Few support cRTP within the in door unit (IDU), requiring additional external devices.

The need for broadband "all IP" enterprise class network solutions continues to grow. iDirect's flexible architecture, built from the ground-up to support IP, coupled with the richness of the iDS, provides an unparalleled enterprise class solution in terms of performance and cost effectiveness.



RTTM Feature	HUB	Space Segment	Remota
1. QoS identifies, classifies and prioritizes traffic			▶
2. SAR, fragments and interleaves to ensure proper de-queuing			▶
3. CIR (static or dynamic, application triggered)			▶
4. Feathering of timeslots minimizes jitter affects			▶
5. Group QoS ensures proper priority across shared medium		▶	
6. cRTP reduces overall bandwidth required	▶		▶
7. QoS, SAR, CIR on the outroute		▶	