SCAsat Audio Distribution: Best of Satellite, Best of WAN

Reliable IP-Audio Program Distribution/Contribution

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Abstract

Changing technology implies a change of practice or process. When a new broadcasting corporation was formed from the merging of several existing broadcaster groups, challenges arose in terms of cost, compatibility, and consolidated operations. Key to efficient continent-wide operations was to re-engineer the audio distribution and contribution network. A worldwide Request for Proposals revealed that no suitable solution actually existed. Engineers from the broadcaster, along with software, hardware, and IT professionals, working together for over two years, fully developed, extensively tested, and have now deployed an ideal audio distribution/contribution solution. Each individual piece of technology - hardware, software, and services - works together providing a cost-effective, reliable, and user-friendly audio and metadata network. The solution incorporates persistently redundant delivery, backup head ends, multiple contribution points, plus full metadata and GPIO, to provide multiple channels of scheduled and ad hoc audio programming for use by local radio affiliates. This paper and presentation describe the parameters, challenges, and technological solutions such that other engineers and broadcasters may integrate or even duplicate the process and results.

Introduction

Southern Cross Austereo (SCA) is Australia's largest commercial radio broadcaster, with 78 analogue and 25 digital radio stations distributed across the entire continent. Each of these stations combine "live and local" programming with networked programs generated from multiple network hubs; often up to four different source cities in any given day.

Due to aging and inefficient legacy systems, Southern Cross Austereo engineers set out to source the most advanced and reliable Audio Distribution system available to provide the most reliable delivery of our networked programs to our audiences around the country. Complete N+1 redundancy was required for the entire system to ensure technical stability, and the ability of non-technical staff to drive the system was a core objective.

After an exhaustive search SCA discovered that there wasn't an "off the shelf" product available that would fulfil all the project objectives. After a Request For Proposal process was undertaken, SCA partnered with multiple equipment vendors to develop and deploy the new SCAsat distribution equipment and the bespoke software used to schedule and manage it.

In a world first, SCAsat uses both satellite and wide area network (WAN) delivery simultaneously to feed live audio to its network of stations. Utilising the best of both worlds, a single audio-over-IP stream sent via two simultaneous delivery paths ensures that downtime is practically non-existent. Again in a world first, the system is driven using a simple object oriented scheduler that is managed by operational staff, and that interacts directly with the SCAsat equipment to manage the complex on-air schedules for all of SCA's radio stations.

Problem Definition

Each of Southern Cross Austereo's 78 analogue radio stations has a unique on-air schedule. All stations have local announcers on-air at some point in the day. Within the SCA network there are up to ten different sources of "network" shows that are syndicated across the various stations in any given day. Many of these network shows are large brands within their own right, and are broadcast across the entire network due to their popularity. From a business point of view, transmission of these large network shows on many stations is critical, as their popularity with listeners is matched by advertisers; therefore they generate significant revenue.

Ensuring the reliable delivery of these programs to each broadcast site was problematic. Multiple acquisitions and mergers has driven dramatic growth of SCA. Its legacy systems, delivering network radio programs consisted of six different distribution technologies that were not integrated with each other. The result: Significant duplication of both technology and human resources to keep all required programming on-air. A single technical fault or human error in any of these systems resulted in an outage across the whole network. As well as being generally inefficient, all the legacy systems were at or beyond end-of-life; SCA had been relying on equipment that is 15-25 years old to keep a continent-wide network of radio stations on the air.

A typical example of inefficiency in the legacy system is when SCA's Sydney station, 2Day FM, would broadcast a network show delivered to all stations in the Today Network. For broadcast in regional Western Australia, the audio was sent from Sydney to Fox FM in Melbourne via an MPEG2 256kbps Harris Intraplex audio-over-IP link. There it was decoded, and re-encoded on another MPEG2 256kbps stream from Melbourne to Sea FM on the Gold Coast in the state of Queensland. It was decoded again at Sea FM, and then uplinked at MPEG2 256kbps to a satellite that covers all of Australasia. This signal was received and decoded at Hot FM Bunbury, in the state of Western Australia. Again this audio was decoded, then re-encoded at MPEG2 128kbps to be uplinked onto a second satellite carrier. This second carrier served SCA's regional Western Australian Hot FM radio network, where local advertisements were inserted then sent to the FM transmitters.

Cascading of multiple audio codec encode and decode cycles caused significant degradation in the audio quality. More importantly, any kind of fault in the technology, or a single human error, broke this chain and caused the downstream stations to go off-air. It was - and still it - quite common for our satellite signals to be affected by bad weather, in which case entire regions of our network used to fall silent. Even worse, if these outages occurred at the start of a network ad break, the "pulse" that triggered the start of local advertisements would not be received, resulting in paid commercials not going to air and a direct loss of revenue.

High-Level Solution

To address these issues, Southern Cross Austereo commenced a search for a world's best-practice distribution network. One that would eliminate all of the traditional problems associated with delivering live audio signals to multiple radio stations with very high reliability.

Initially SCA engineers expected that there would be a commercially available product that would achieve these outcomes, given this is a common problem for large radio networks around the world. After a series of meetings with equipment suppliers, SCA determined that whilst there were some excellent and ground breaking products available, there was no single solution that would cater for all SCA's required outcomes. An integrated solution would have to be developed with multiple equipment vendors.

The heart of the SCAsat system is the Telos iPort audio codec. This equipment was selected to handle all encoding, decoding, and transfer of audio around SCA's radio network. The Telos iPort contains up to 16 codecs that can receive simultaneous audio streams across different network segments for redundancy.

Southern Cross Austereo selected IP distribution via satellite as the most efficient primary distribution method for these audio signals. To cover for any satellite outages due to weather / equipment fault etc, SCA also deployed a next generation wide area network to allow all the on-air audio streams to be delivered to each radio station via a computer network for redundancy. This combination of satellite and WAN audio delivery ensures that the receiving radio stations are practically guaranteed to stay on-air even during significant weather events or a prolonged technical outage.

Southern Cross Austereo partnered with Audio Visual Consulting (AVC) to develop and intuitive interface for scheduling each stations' on-air content, which communicates directly with the Telos audio equipment to generate the correct audio streams from the correct locations at the correct times. Day-to-day management of the SCAsat audio distribution system is handled by operational staff, with no involvement from SCA engineers.

Solution Details

After the initial product investigation proved unsuccessful, Southern Cross Austereo developed a Request For Proposal document outlining the end needs for the new system. This RFP was deliberately kept “technology agnostic” to allow the broadest possible range of responses; SCA wanted to ensure that it wasn’t dictating initial technology expectations onto possible vendors, as it’s the vendors who have the best knowledge of how to utilise their own product.

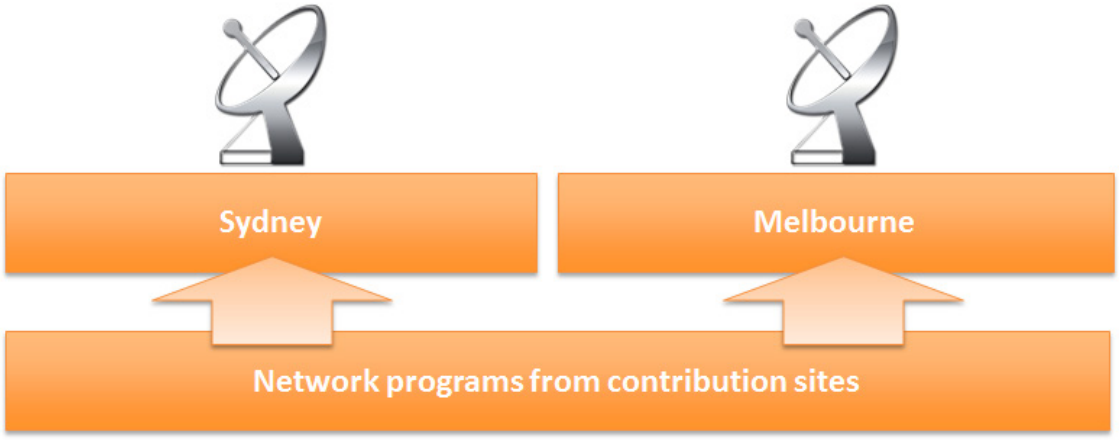
After the RFP responses, it quickly became evident that satellite was still the most effective way to deliver audio signals to sites in such diverse geographic locations. However Southern Cross Austereo’s experience of existing satellite systems showed that they could never be perfect; downlink rain fade, predictable “sun transit” interruptions, and occasional technical outages meant there was still a need for additional redundancy.

After working with many equipment vendors, SCA selected the Telos iPort as the audio codec that would be deployed for the SCAsat system. Working with Telos directly to develop the product, SCA identified three key advantages with this technology platform:

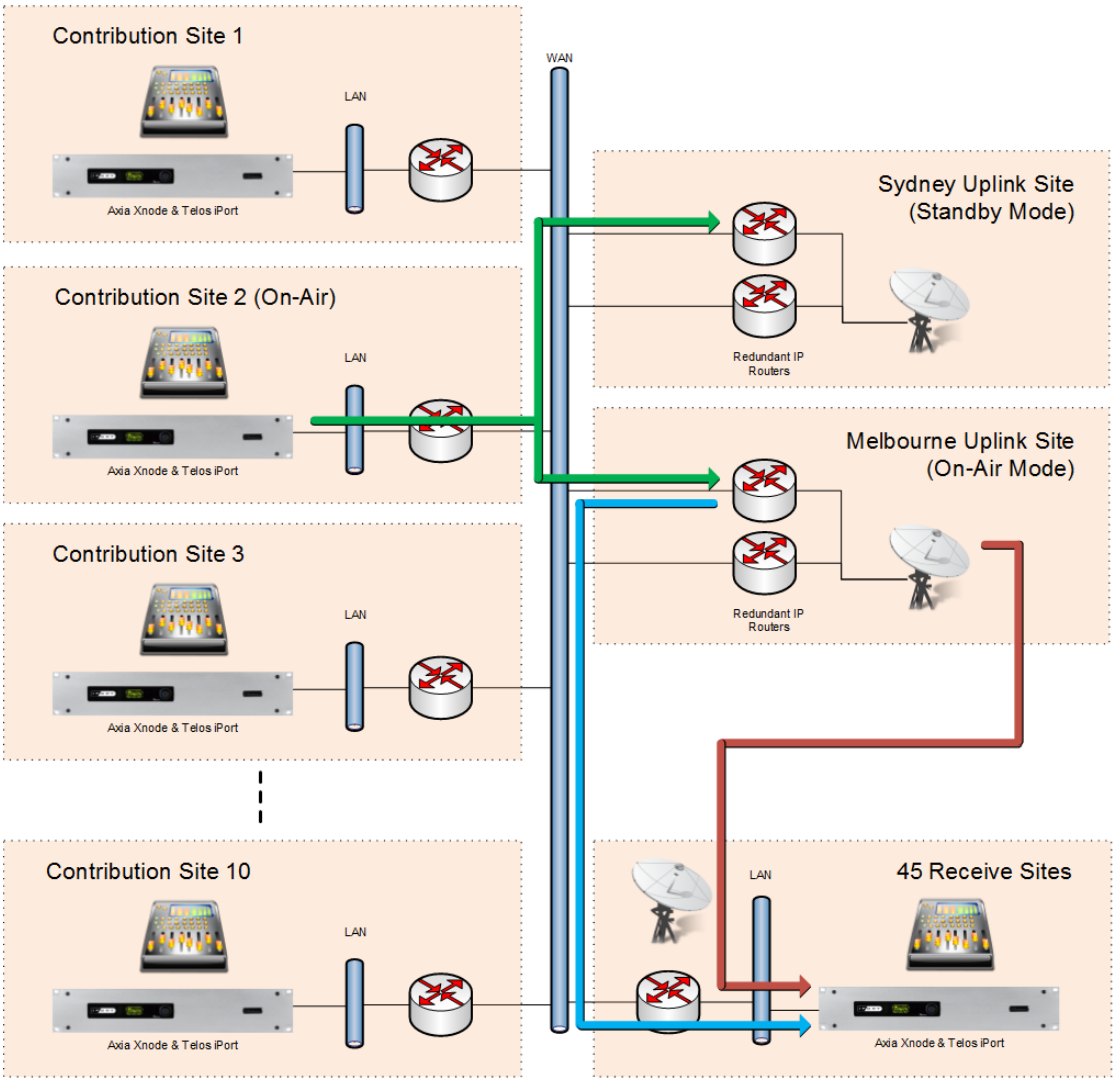
1. Density - a single Telos iPort codec contains up to 16 audio codecs, each with the ability to send redundant IP-audio streams to multiple destinations.
2. Multiple Paths - a single iPort decoder can accept IP-audio streams from multiple simultaneous network paths. As long as the audio stream is valid on one of these paths, the decoder will produce audio.
3. Time Zone Delay - SCA’s network crosses four different time zones in Australia - five time zones in summer - and the Telos iPort can delay any incoming stream for a configurable period of time. Having this time zone delay at the receive sites adds system flexibility, and reduces uplink inefficiency as all network shows are only sent once from the source site.

The SCAsat system consists of two satellite uplink earth stations, one in Sydney and another in Melbourne. SCA's networked content can be sourced from any of ten sites: Sydney, Melbourne, Brisbane, Adelaide, Perth, Gold Coast, Albury, Bunbury, and Townsville.

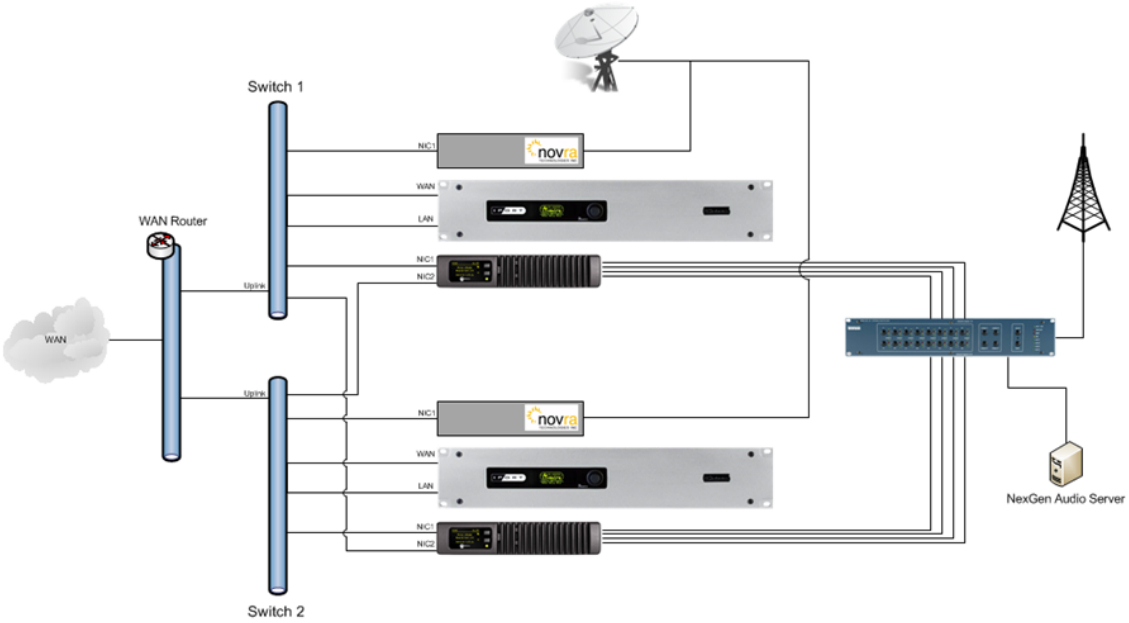
To distribute these network shows, the source studio creates the audio and then encodes it using a Telos iPort audio codec. This codec sends the encoded audio stream to the Sydney and Melbourne uplink sites simultaneously. All of the incoming audio streams are aggregated at both uplink sites, only one of which is selected to be "on-air" at any given time.



The selected uplink site radiates a DVB-S2 stream containing all of the audio streams onto the satellite. At the same time, the selected uplink site also presents these audio streams onto the SCA WAN for IGMP subscription. Using this method, a single uplink site is offering all network audio streams to the rest of the country using both satellite and WAN technologies. The second uplink site is receiving all audio streams and remains online as a "hot standby" for the current uplink site.



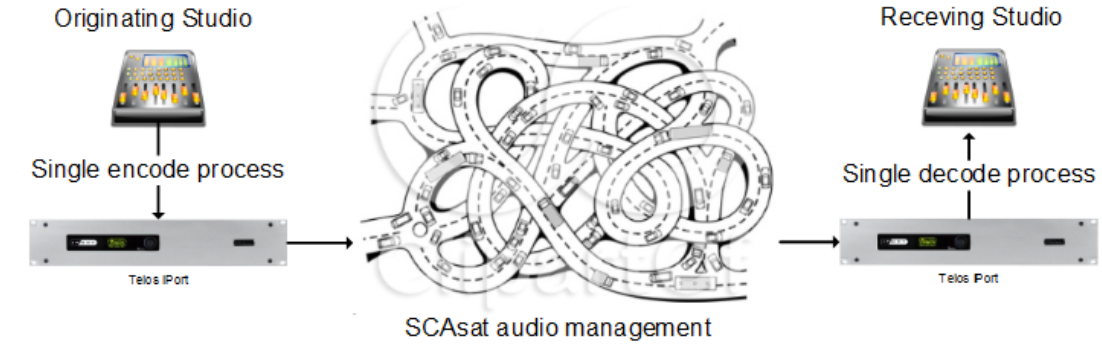
Each receive site across Australia is equipped with Novra S300 satellite receivers, Telos iPort audio codecs, and Cisco IP switches. Every system component is duplicated for redundancy, ensuring that no single equipment failure can cause an off-air event.



Both the satellite delivery path and WAN delivery path use standard IP-audio streams, meaning that both paths appear to be a standard network connection to all of the system equipment. The Telos iPort is configured to receive the same audio stream on both delivery paths, using unique multicast addresses. The iPort doesn't switch between the two paths; they are both providing IP packets constantly into the iPort receive buffer. As long as the iPort can see a valid packet - regardless of its delivery path - it passes to the decoder and subsequent audio output. Using this method, a sudden loss of one of the delivery paths has no effect on the audio received.

The satellite delivery method contains all system channels by default; if it is on the satellite, it is received everywhere. However this would be inefficient if the same process was applied on the WAN; each system channel occupies network bandwidth, and carrying all system channels to each receive site on the WAN would require a lot of expensive bandwidth into all sites. To get around this, the uplink site provides all WAN streams using IGMP, also known as IP-multicast. The receive-site Telos iPort requests only the audio streams it is actually using. Therefore only these requested channels traverse the WAN segment to the receive site. Using this method, only a small amount of bandwidth is required for the receive locations.

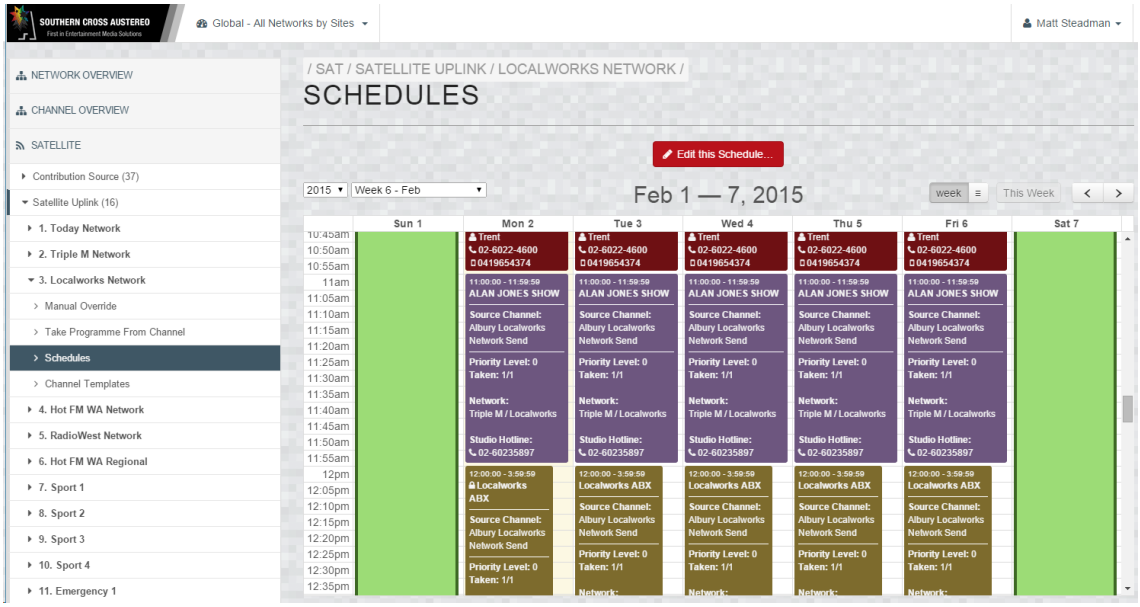
Having Telos iPorts at the perimeter of the SCAsat distribution network also eliminates one of the key issues with the legacy systems; all system audio is only encoded and decoded once. There is never any cascading of audio algorithms from the input to the output of the SCAsat distribution network. This affords the highest level of audio quality available to all the receive stations. The improvement in audio quality is noticeable, and even remarkably better at many locations.



In addition to the audio, various commands are embedded into the codec stream to signal the remote stations to take certain actions, such as starting local advertisements. By embedding these commands into the audio stream, correct time alignment with the audio is guaranteed, and the commands have all of the same redundancy protection as the on-air audio.

In receive locations that require it, the Telos iPort can also set a fixed delay on individual audio streams to cater for different time zones. A program originating from Fox FM in Melbourne at 4PM local time would arrive in Perth at 1PM local time; this is then stored within the codec for 3 hours before being output at 4PM Perth time. Performing this delay at the receive end means that all programs are transferred through the system only once, resulting in a very efficient use of satellite spectrum and WAN bandwidth.

Southern Cross Austereo partnered with AVC to create a piece of software that would manage the SCAsat system, and ensure the correct audio signals were sent and received to the correct stations at the correct times. With over 78 stations and 15 system channels, the on-air schedules are very complex. Under our older system, operational staff would make decisions about which programs were needed on what stations at what times. This information was then communicated to Technology staff, who would then interact with the multiple distribution systems to setup the correct feeds. SCAsat absolutely eliminates all of this; the operational staff simply drive the one piece of software that directly controls the equipment.



To make this complex schedule as approachable and "easy to drive" as possible, AVC created an object-oriented schedule where individual programs are defined as on-air events. They are then dragged onto a calendar interface and saved. Using this visual approach, multiple users can operate the scheduler and easily see what it already scheduled. Most operational users are familiar with the calendar in Microsoft Outlook, for example; this software allows them to drive the Southern Cross Austereo radio network using identical workflows.

There is no middleware to integrate this management system with the hardware; the SCAsat scheduler is the same piece of software that communicates directly with the Telos iPort codes to establish the correct audio streams at the correct times.

The SCAsat software created by AVC handles alarms and basic system monitoring, not only of the equipment but also the on-air schedules. If there is a scheduling conflict, the SCAsat software will detect this and generate alerts for the appropriate staff to deal with.

Business benefits

As Australia's largest commercial radio broadcaster, reliable delivery of on-air audio to Southern Cross Austereo's radio network is critical to business performance. The age of the existing system meant that significant capital expenditure was due simply to maintain the current business model; a wholesale failure of the legacy systems due to ageing equipment would have a large impact on revenue.

Through the world-first development of dual-path audio delivered outlined above, SCA has ensured that this investment goes much farther than a simple replacement of an existing system. SCAsat improves the on-air reliability of network audio signals to a much higher level than traditional satellite- or codec-based distribution networks. SCAsat also allows for a far greater number of audio channels compared to the legacy systems, meaning SCA can send more shows to more places, increasing on-air flexibility and opening new business opportunities.

Most importantly, by making use of more efficient audio codecs, and combining legacy distribution contracts into new single agreements, SCAsat has an ongoing operational cost that is less than half of the cost of the outdated legacy systems. On top of this, further cost efficiencies are expected from the reduction of duplication of operational tasks, the ability to schedule a whole radio network in much less time than it currently takes to setup the correct feeds, and future efficiencies from having a single database of all Southern Cross Austereo's on-air content.

Summary

Broadcaster Southern Cross Austereo embarked upon a project to replace their aging and unreliable distribution system that feeds live audio to 78 radio stations. After a consultative process with many vendors, SCA partnered with Telos and AVC to develop SCAsat: a world-first distribution system that sends audio streams via both satellite and WAN to its network of radio stations. This simultaneous dual-path topology ensures the highest possible level of redundancy and reliability.

In addition to this improved reliability, SCAsat improves on SCA's legacy distribution method by having an increased number of audio channels, far better audio quality, and more flexible network capabilities.

SCAsat is managed by custom-built software that is designed for non-technical staff to drive. Based around an object-oriented program schedule, controlling the hundreds of individual pieces of audio equipment that forms SCAsat is as easy as dragging a meeting into an Outlook calendar. Allowing operational staff to manage their own on-air systems increases business efficiency and eliminates unnecessary work for technical staff.

Through the use of more efficient encoding algorithms and by bundling existing telecommunication contracts into a new single agreement, SCAsat halves the operational cost of Southern Cross Austereo's audio distribution network whilst delivering all of the above improvements.

SCAsat fully leverages the capabilities of modern audio equipment, and via innovative use of both satellite and WAN technologies provides Southern Cross Austereo with the most reliable live audio distribution network in the world.

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