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WorldSpace Satellite Radio

S. Rangarajan

Issue 12: Satellite Radio - WorldSpace

Synchronous and Asynchronous Education Delivery

There are significant challenges to the delivery of quality education to less-developed nations. The primary obstacle is the lack of available and affordable connectivity solutions. Broadcast satellites can play an important role to fill this void. Particularly, digital broadcast satellites can provide audio and multimedia contents to multiple locations simultaneously. WorldSpace, with its extensive reach and low-cost terminals, offers a viable solution to increase the access to global educational resources. This solution includes audio formats, asynchronous multimedia delivery and creation of virtual classrooms with instructor-led, synchronous delivery of audio-visual presentations. These help enhance the quality of education delivery across Africa and Asia.

Education is paramount to better societies and more fulfilling lives. Unfortunately, millions of young people - particularly in remote regions of Africa and Asia - are out of school due to a shortage of qualified teachers and inadequate learning material. Providing quality education in rural territories has traditionally been a difficult and expensive endeavor. Today, however, new technologies can move us closer to realizing the vision of ubiquitous education.

The Challenge

The findings of an UNICEF-funded study undertaken by WorldSpace for Southern Sudan in the summer of 2005 are representative of the key issues facing the Education sector in underdeveloped areas. They include:

- Insufficient number of trained teachers.
- Insufficient number of teacher training centres and faculty.
- Insufficient learning materials in schools.
- No facility to access study or teaching materials.
- No electrical communication system.
- No avenues for accelerated adult education system.
- Gross gender disparity in school enrolment and completion.

Satellite Radio for Improving Education

Since the launch of the first man-made satellite half a century ago, continuous efforts are underway to develop their applications for the betterment of mankind, taking into account the vast coverage and universal reach that satellites provide.

Over the last thirty years, a number of innovative developments have occurred to harness space technology for education. However, it is only recently that digital audio broadcast from a satellite is available commercially.

Radio has evolved through several stages, the latest being the concept of a satellite radio, where a satellite in a geo-stationary orbit broadcasts crystal-clear music and news directly to listeners. A satellite radio delivers a diversity of formats, languages and genres, which is not feasible by terrestrial systems. Further, satellite radio has taken advantage of the tremendous advancements in digital technology, such as forward error correction, selective addressing and advanced audio compression, resulting in better quality and resilience to noise impairments.

WorldSpace System

WorldSpace Satellite Radio has designed its system expressly to serve the developing world. It uses satellites to broadcast digital audio and multimedia programs directly to compact, portable receivers. It operates two satellites: AfriStar™, serving Africa, the Middle East and Europe, and AsiaStar™, serving Asia.

The WorldSpace satellite has three spot beams. Each beam contains two Time Division Multiplexed (TDM) carriers centered at different frequencies in the 1452-1492 MHz band. Consequently, with the six beams on the two satellites in service, the coverage extends to more than 130 countries in Asia, Africa and Europe, as depicted in Figure 1.

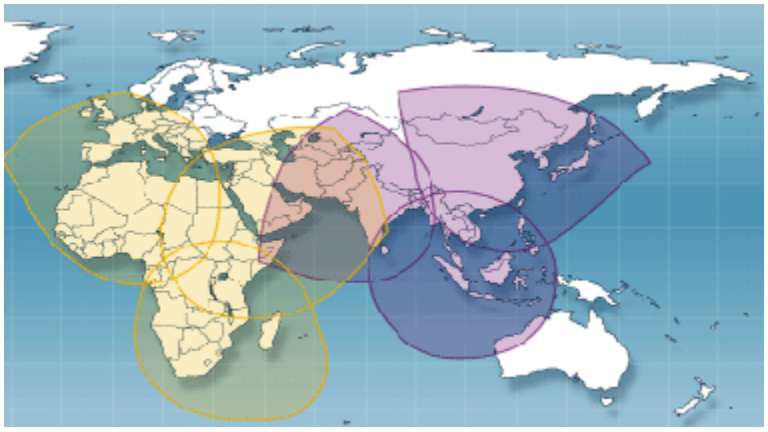

Fig. 1: Geographical Reach of WorldSpace

Each TDM carries 1.536 Mbps, divided into 96 Prime Rate Channels (PRC), 16kbps each. Every audio program uses one Broadcast Channel (BC), and a BC can use anywhere between 1 to 8 PRC, depending on the desired audio quality. The WorldSpace digital format incorporates interleaving, Reed-Solomon and convolution encoding technologies to protect the service against transmission

errors. Typically, 30-40 audio channels are available at any given geographical location.

Different end-user antennas, such as a palm-sized patch antenna, or a short or long yagi antenna can be used to receive the services. The satellite signal is strong, with an Effective Isotropic Radiated Power (EIRP) of 53 dBw; hence, even an inexpensive receive system with a figure-of-merit (G/T) as low as -13 dB/K can decode the satellite signal.

All WorldSpace-specific processing, including MPEG decoding, are handled by the StarMan chipset, which is incorporated in all the WorldSpace receivers. Every radio receiver features a BC digital output connector, allowing access to the full content of the selected BC from an external appliance.

WorldSpace has the capability to easily reach widely dispersed geographic locations and even areas with no telephone connectivity. This extensive reach is further augmented by alternative power-supply solutions that address the lack of connectivity to public electrical power grids, as shown in the figure below.

Fig. 2: Solar Powering of WorldSpace Radios

WorldSpace Satellite is inherently a digital broadcast medium, and can be tailored to provide a variety of one way, one-to-many type of data services. In this era of inexpensive computers and storage devices, it is viable to expand the range of services far beyond traditional "radio", as shown in Figure 3, to include:

- Multicasting, namely, the distribution of digital contents simultaneously to a Closed User Group (CUG) in multiple locations.
- Live lectures based on PowerPoint® presentations with the possibility of real-time annotations.

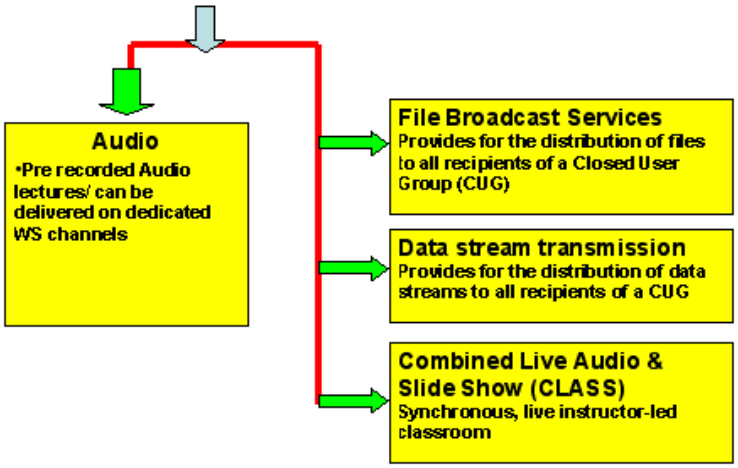

Fig. 3: Overview of the various applications on WorldSpace

Importance of Audio for Distance Education

The human voice bears a personal touch to the learning experience. Students enjoy and benefit from live presentations by good teachers, with the extemporaneous delivery, intonation, phrasing and pacing. Hence, WorldSpace system, which provides digital audio with fade-free, noise-free reception across vast territories, can be leveraged for distance education.

For example, WorldSpace has dedicated one channel on its AfriStar™ satellite to broadcast education to 11 million children in Kenya's 18,617 primary and 3,245 secondary schools. According to the Government of Kenya, neither contracting with the local individual broadcasters, nor investing in a terrestrial broadcast channel proved as valuable as the complete and cost-effective package for instructional broadcasting and information dissemination offered by WorldSpace. Figure 4 illustrates how well the satellite-delivered lessons integrate with what the local teacher has to offer.

Fig. 4: Integration of Audio Lectures via WorldSpace into the curriculums

IP Multicasting

Multicasting is the distribution of contents simultaneously to multiple locations. The IP Multicasting solution of WorldSpace provides a web-like user interface to

upload the content to the uplink site and set up the transmission. The recipients of this information are individually addressable.

A WorldSpace receiver connected to a personal computer acts like a wireless modem, capable of downloading several megabytes of data every hour. For the data transmissions, a BC of 128 kbps is used and the bit rate is allocated on this channel dynamically, therebyallowing several Closed User Groups (CUG) to share this channel.

In the context of educational institutions, the possibility of pre-loading selected contents on a local server and keeping it current by the satellite connectivity leads to much better control of the contents, and also improves the access times for the user. In case of a Local Area Network at the receive location, it is sufficient to provide the WorldSpace connectivity only to the server.

WorldSpace also provides an easy interface to pull out selected contents from the web and push them via the satellite to the subscribers. As the web access preferences are largely predictable in the context of curricular education, it is possible to identify the websites that need to be locally cached. A good user interface is provided for browsing the cached contents.

Digital technology provides the WorldSpace system with versatility far beyond traditional radio as it can deliver text, data, images and even streaming video. For some topics, learning is definitely aided by multimedia delivery. This data distribution capability has critical importance in areas where Internet access is expensive, unreliable or simply nonexistent.

Figure 5 shows how easily the satellite connectivity can be set up and how the received contents can act as a local digital library.

Fig. 5: Delivery of multimedia contents to remote communities

Combined Live Audio and Slide Show (CLASS)

CLASS is an innovative solution intended to leverage the capabilities of the WorldSpace system for distance education in developing countries. It combines the audio and data broadcast functionalities to create virtual classrooms at multiple locations. The return path is optional and is provided through an Internet

link. The combined bandwidth needed in real time for the audio and the slide presentation is approximately 16 kbps only.

CLASS technology facilitates a smooth integration of media to support education across vast territories. Some of its features include:

- Delivering live lectures with accompanying PowerPoint presentations directly to students' PCs (direct-to-home, or schools) at a scheduled time.
- Enabling students to listen to the best teachers, while following associated presentations and getting real-time updates as the teacher works through the material.
- Enabling students with Internet access to pose questions and to provide feedback in a text-chat mode during the lecture itself.
- Delivering presentations, lesson plans and other multimedia materials to students, thus complementing and expanding the classroom lecture.
- Using the same system for teacher training and vocational training when it is not used for the regular classes.

CLASS Requirements:

The live audio of the speaker is coded using an AAC+ encoder, and sent along with the slide control information generated on the Speaker screen. At the student's end, the CLASS slide show viewer software presents the slides while the AAC+ player decodes the audio. The computer at the receive end has to be Pentium class with a multimedia kit. The application runs on Win 98 or higher Windows operating system. The software modules that get installed include the WorldSpace datacast software, the slide show viewer and the AAC+ player. If the student's location has Internet access it is possible to raise a question in a text-chat mode during the class itself. The answers to the questions are delivered through the audio channel, thereby benefiting all the listeners.

Fig. 6: CLASS Speaker screenshot

Figure 6 shows a typical screen of the CLASS teacher. The central box contains the slide. At the top left are the buttons to move the slides. Provision exists to clear the screen and get a white board for freehand writing. On the left of the screen are the symbols for annotating the slides in real time. The bottom window is for receiving the queries from the students sent during the course of the lecture by using an Internet chat server.

An example of a CLASS network that is set up nationwide is the Sri Lankan Network for e-Health and Alerts (SNeHA). Medical professionals in the remote district centers use this network for continuing medical education, to update their knowledge and pass better health care to their patients.

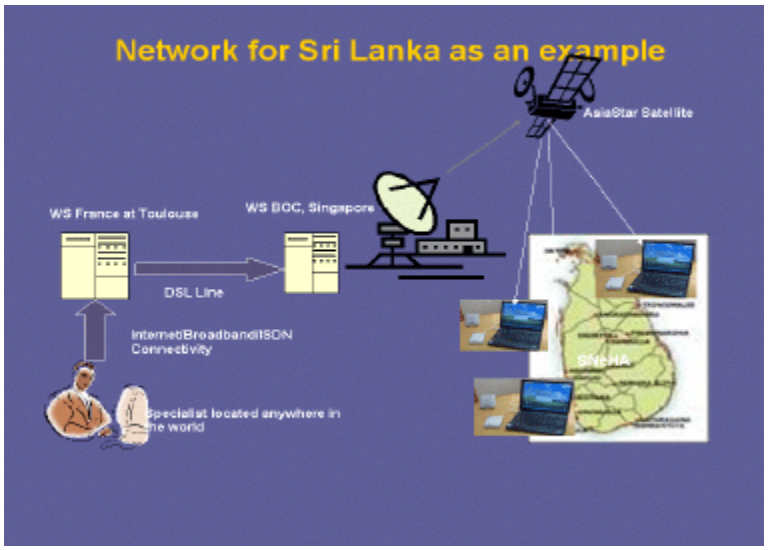

Fig. 7: Use of CLASS for Continuing Medical Education in Sri Lanka

Conclusion

The table below summarizes the advantage of using WorldSpace in the context of school and higher education.

The underdeveloped regions are characterized by their poor/expensive infrastructure in terms of communications, power and manpower. WorldSpace can deliver with ease audio and/or multimedia content to small portable radios or to PC's connected to these radios. Without the need for telephone lines or Internet, these computers can be fed with pre-selected Internet content or any other digital data.

As the system supports simultaneous audio and data transmissions, properly synchronized, it can provide high quality Combined Live Audio and Slide Show (CLASS) to extend the reach of the best teachers to more people. In places where an electrical power supply is not available the system can be run on solar-charged batteries. These networks can be created quickly, are scalable and sustainable with local manpower.

Therefore, with an ability to surmount barriers of geography, ethnicity and poverty, WorldSpace system holds a great potential to improve education delivery across Africa and Asia.

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