SDE Technology Platform

Proprietary to

Phoam Technologies

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Executive Summary

Phoam Technologies has developed a novel and fundamental technology, known as Submarine Data Embedding (SDE). It is a Digital Vehicle for the past, present and future of digital media and automation. SDE is fully backwards and forwards compatible and broadly applicable.

SDE creates an additional data channel inside *any* digital media, without increasing the file size. Business and industries – like merchandising, advertising, up-sells, automation control, telematics, network optimization, downloads, interactive music videos and games, etc. – are all made simple and easy with this breakthrough technology. It integrates seamlessly into several trillion-dollar industries, making ubiquity a reasonable and achievable goal.

The technology works on all kinds of playback and wireless devices, such as cell phones, VOIP telephones, PCs, digital TVs, PDAs, mp3 players, car stereos, etc. Existing hardware and software keeps working. SDE is fast and easy to integrate with media codecs. This Universal Digital Convergence Vehicle lets you put anything in anything.

How Does Phoam Do It?

The technology is proprietary. Basic mathematics and a redefinition of the channel concept are the key. Unused mathematical resolution of the transform function is a basic element of this patented process. SDE does not use the data space, but excess channel resolution. This lets it easily insert and separate the virtual channel from the existing systems.

SDE allows for large quantities of data to be hidden in digital media files such as audio, video, images and 3D. This is unapparent to the viewer, and doesn't interfere with the media files. SDE is capable of placing data in these files, an order of magnitude better than any comparable technique, such as Least Significant Bit embedding.

Depending on the media format and the desired user experience, SDE can "borrow" from 4 to 15% of the bits in a multimedia stream. For example, SDE has been used to add a 400k interactive advertisement to a 4-megabyte mp3 song, with minimal effect on the listener's experience. It's like adding a small floppy disk inside a song.

SDE can already embed data in MP3, JPEG, MPEG, and GSM. In addition, the technique is powerful and works easily with CDMA, facsimile, GIF, CD audio, AAC, AC-3, or with any digital media format.

The SDE technology is simple and quick to integrate into an existing codec. In actual practice, it has taken about a week from "opening the manual" and learning about the codec, to having a working prototype version of SDE for that particular codec. The *SDE Technical Manual* describes the process of applying the technology to a codec.

Industry Segments

Phoam's SDE technology revolutionizes any field that uses digital media. Here are some of the larger industries that it applies to: digital entertainment, advertising, telecommunications, cell phones, military, and manufacturing.

Digital Entertainment

Digital Entertainment is practically everywhere – CD, DVD, mp3, Digital Surround Sound, Digital Cable and Digital Radio are just the bare beginnings. And the shift to digital is shaking up and transforming entire industries.

Worldwide:

- Entertainment and media is almost a trillion-dollar industry.
- The film industry grosses about $65 billion.
- In 2005, people spent $33 billion on recorded music.
- The global television market is about $180 billion.
- Downloaded music revenue was $1.1 billion in 2005 (tripling from 2004).

With Gnutella and related music-sharing technologies, the recording industry is already running scared, ready to try almost anything to keep control of its own industry.

The free distribution of music over the Internet is only the beginning. Compression technologies based on MPEG-4 threaten the film industry. Anyone can "rip" a DVD and shrink it to a few hundred megabytes, using freely available Internet tools.

Phoam's SDE technology monetizes the digital distribution of media. If every song or movie contains advertising, up-sells, and merchandising, then downloads become a source of revenue. Piracy transforms into profits.

Disney's film *The Lion King*:

- Was produced for $55 million.
- Made $313 million in U.S. theaters and $450 million in foreign.
- Sold $500 million of videos.
- Children bought $3 billion of Lion King Merchandise.
- For every dollar grossed in theaters, they sold $4.60 of products.

Studios make a substantial portion of their profits from merchandising. With SDE, studios, distributors, broadcasters, content providers and copyright holders can turn their media assets into merchandising machines.

Advertising

The advertising industry is also enormous. SDE can place advertising in *any* digital media. Digital TV, mp3 players, digital radio, online digital entertainment, car stereos, PDAs and cell phones are just the beginning. What is it worth to be able to place advertising in *any* digital media: past, present, or future?

In the U.S alone:

- In 2005, $267 billion was spent on advertising.
- $12.5 billion of that was spent on Internet advertising.
- $54 billion was spent on cable and broadcast TV advertising.

Digital devices such as ReplayTV and TiVo have made it trivial to skip TV commercials. SDE creatively embeds the commercials directly inside the content.

Cell Phones and Telecommunications

SDE can place an additional data channel in a GSM or CDMA cell phone conversation, or even in a VOIP (Voice over Internet Protocol) telephone. Corporate logos, menus, and up-sells can all be embedded in the on-hold and call-response systems of corporate customers. This entertains the customer, allows him or her to get information and navigate through the system faster, and provides additional revenue from targeted advertising.

Two people can show each other the web sites they're browsing, while they're talking on the phone – say, to exchange stock information. One very interesting application is video games people can play while talking on the phone together – even a simple chess or poker game gains much more interest when you can talk with your opponent in real time. The potential for collaborative play and work environments is staggering.

A few dozen different digital cell phone and VOIP codecs[1] have been deployed on various networks – enough acronyms to make a whole pot of alphanumeric soup. Each

[1] For example, Ditech's VOIP transcoding product supports G.711 μ-law, G.711 A-law, G.723.1, G.726, G.729, G.729a, G.729b, G.729ab, G.729e, G.729g, iLBC, G.722, G.722.1, G.727, G.728, GSM-HR, FR, EFR, GSM-AMR, G.722.2 (AMR-WB), VMR-WB, EVRC, EVRC-B, EVRC-WB (4GV), Speex, BroadVoice® 16/32, iSAC, and iPCM-wb.

type of codec compresses speech data through modeling audio processes and throwing out sound information that the listener is unlikely to hear. Any particular codec may do a great job in compressing speech and playing it back, but every codec does this in a unique way, much like two poets describing the same sunset in different languages.

When two phone users are communicating across different networks, or even with different generations of phones, information in one codec has to be translated into another codec, in a process called transcoding. Like efforts to translate poetry from one language to another, information is going to be lost in translation. However, SDE can help this transcoding process. For example, a GSM codec could embed an additional data channel with parameters used in CDMA encoding, so that the GSM to CDMA transcoder can make better choices when converting between the formats.

This is related to the abilities of SDE to extend and enhance formats, described in a later section of this document.

Manufacturing and Automation

Automation and business communication is another area where there are enormous quantities of legacy equipment and networks. It has been estimated that the industrial business-to-business marketplace is worth several trillion dollars – an order of magnitude larger than the entertainment industry. This is where the real money is. SDE is positioned perfectly for the present and unforeseen future of industrial upgrades.

As an example of the value of backwards and forwards compatibility, HART is the dominant communication protocol used in manufacturing automation. It was so successful because it created a digital data channel inside the existing analog control lines used in factories. Factories now need to upgrade their first-generation digital control systems. SDE does that and more.

A new car has:

- $500 worth of steel.
- $700 worth of silicon and software.
- $1000 worth of litigation reserve.

These last two need communications, including video and up/download. The auto industry expects a vehicle will eventually have 20% of its value in software, communications, and hardware.

Ford and GM collectively manufacture 10 million cars per year. Currently, the silicon and software portion is a $7 billion industry.

Applications

There are a number of obvious and not-so-obvious applications of SDE. It can be used anywhere it may be useful or necessary, either now, or in the unforeseen future, to add additional functionality through new data channels.

Adding New Functions to Formats

The most obvious use of SDE is extending, enhancing, and upgrading existing media formats. It can add data to the formats without affecting their backwards compatibility. This means that extensions do not break legacy players/viewers and network components. Legacy applications can still view the media file, and to all extents and purposes, it is as if the extended data did not even exist. And new players/viewers and network components can seamlessly take advantage of the extra, embedded data to gain new functionality. This makes it easy to add intelligence to legacy networks, without having to simultaneously upgrade all the components of the network.

SDE is an excellent way to make changes to a format, independent of a standards organization such as ITU, ANSI, or ISO. Because these changes do not affect the usability and interoperability of the media format, they do not affect the standards

compliance. So you can create value-added services and extensions to existing standards without breaking those standards. Because it takes advantage of the general properties of compression, SDE can work with any format or new standard that evolves, and it won't become obsolete.

For example, later work on a vocoder codec may show that it is possible to gain significantly more clarity of speech through the addition of a few parameters that were not understood when the vocoder was submitted to a standards body. Rather than having to introduce a new standard, ratify it, and upgrade the entire system for the sake of an incremental improvement, it is possible to embed these additional parameters in the existing vocoder voice stream. This way, new equipment gains the benefits of the extension, but equipment which has not been upgraded does not break, and seems to operate exactly as before.

The capability of enhancing formats is not limited solely to legacy formats. SDE provides a "submarine back door" advantage to make future improvements and meet unforeseen technical needs. Anticipated design changes are easy, but you can never anticipate every need or design change. Any successful format ends up being used everywhere, including situations that the designers never even envisioned. For example, it may be necessary to add additional sound or color channels to a digital cinema system, or even to add smell-o-rama or animatronics equipment control codes. With SDE, it is straightforward to do this. It prevents you from being locked into a particular design, or being forced to use ugly, case-specific hacks to extend a format. And you no longer have to worry about equipment cross-compatibility and undocumented features. One need only look at HTML to see the cascading incompatibility effects of widespread hacks to a very successful format.

Embedded Data

What types of data might be useful to place in media files? Anything you want, anywhere you want simplicity of packaging and distribution. In this section, we have listed a number of applications, but the possibilities are practically endless. Co-branding

and up-sell opportunities flourish. Cross-branding the digital lifestyle becomes an instant reality.

One of the most obvious uses is to include merchandising and to place advertising in these files, to allow for their free download and distribution. Once you've done this, every download of a file, every time it is copied, becomes another source of revenue. The Napsterization of the digital music and video world, instead of being a threat, now becomes a venue for content producers and distributors to generate revenue.

In addition, games, polls, interactive music videos, ringtones, and other types of rich content can be added to media files, providing enhanced value and interest. Since the embedded data is part of the media stream, it becomes trivial to synchronize the data with the media – they are intertwined, so they show up exactly where they are placed in the media.

Any type of executable code can also be placed in a media file. This could be applications; for example, a BREW-based stock trading application for a cell phone, or software updates for applications running on the system. SDE provides for new capabilities to be streamed to a media player, while it's being used.

When the user is off-line, SDE can display an entire web site embedded in a song. For example, a portable music player can let the listener explore a web site to find out about an artist's background, upcoming concerts, and other songs the artist has recorded, without needing an Internet connection.

Media files can even contain other media files. Videos can contain other videos inside of them, to be extracted under certain circumstances. Advertising can be targeted on a demographic or other basis, and be invisible otherwise. It has been suggested that commercials could be associated with product placements in movies, and shown for selected audiences when the product appears in the film.

Users can annotate and mark up media files. For example, doctors can mark up X-rays, circling significant features and writing notes, and store the data directly inside the X-ray, so that there is no chance of the annotations being separated from the picture itself. Or a

fax could contain an ASCII representation of the text which is being sent, so there is no need to use OCR techniques to import the fax into the computer. With SDE, if you fax a contract to someone, the digital text is embedded in the fax, so you can pull it right up and edit it on your computer.

Secure music technologies use robust, low-bandwidth watermarks to discourage unauthorized duplication. Because SDE allows so much data to be embedded, it can also provide an "anti-watermark" to remove the robust watermark for properly licensed viewers. This would be useful for distributing media libraries which can be unlocked on demand, when licensing information needs to be changed to reflect a new owner, or even for audiophiles to improve the quality of their music. For example, SDE can improve the quality of watermarked files by removing any residual changes the watermark introduces.

SDE could provide an integrated communications dashboard – Internet phone, video phone, mp3 player, Internet radio, fax – a communications-central e-mail client. This would embed e-mail, business cards, annotations, applications, and other data in the RealAudio, H.263, mp3, etc. streams to support it all through advertising, rich interactive content and games, up-sells, etc. This would even integrate tightly with your cell phone, contact management software, etc.

Two-Way Data Channel

SDE does not have to be used solely for delivery of static data. Since it adds so little overhead to the codec, SDE can also add data to media files on the fly. This is particularly useful for video-conferencing and telephony applications.

As an example, one could set up a two-way TCP/IP connection while talking on a cellular phone, and use WAP for web-sites and e-mails. Further examples of this were previously described in the Cell Phones and Telecommunications section, on page 4.

Network Routing/Optimization

When data is being sent over a network, routers and switches typically have only a local view of the conditions on that network. One technique used in manufacturing is to employ a faster-than-real-time simulation of the current state of the factory, and to use this simulation to better schedule resource usage. This technique can be easily applied to terrestrial and satellite networks, and is especially useful for delivery of real-time media files. Big, big money is spent on building, maintaining, and optimizing these networks. Improving the performance and upgrading functionality without upgrading the entire infrastructure is extremely valuable and lucrative.

With this technique, a simulator models the entire distribution network before transmitting a file, determining the best routing for the message based on current and anticipated delays in the network. Then the routing information is embedded in the file using SDE, and it is sent out. "Smart" routers, which can read the SDE information, follow the instructions and send it on its optimal route. Any routers along the way which haven't been upgraded, work the same way they always did, sending the file along using local information. You do not have to upgrade the entire network at once to improve performance.

Secret Messages

Since SDE embeds data into a media file without being apparent to the viewer, one can place secret data into the media file. For example, if one places a secret message inside a media file, this may be useful later to prove the original source of the media file or to prove authenticity. Of course, SDE has obvious applications wherever secret messages have traditionally been used.

SDE can download new encryption keys to a system on the fly, encrypting them using the old key. This is good for software and security upgrades.

About Phoam

Phoam Technologies is an intellectual property development company. The principals include: MIT Physicists – an Invention Hall-of-Famer, Emmy-award winning composer and world-class IP attorney who invented the sonogram, radar, and high-definition radar – and an Automation Hall-of-Famer who invented the Programmable Logic Controller (PLC), the floppy disk and drive, anti-lock brakes, and the hand-held computer terminal – Multimedia Pioneers – a film, video, and television producer and director whose content was used in one of Apple's first interactive prototypes – and a computer scientist and VR expert who worked with NASA, created the first film on the Web, and standardized VRML for MPEG-4.