DOES YOUR YOTTA BYTE?

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Terms like gigabyte and terabyte are part of our everyday language. Others like 1080p, HD Radio, HDMI and Voice over IP can also be classified as part of our daily vernacular in the radio business, but only a few years ago they were virtually unknown to most. This is a brief study of 'the now' in broadcasting but also a glimpse at the not-too-distant future where the unknown terms of today will soon be part of our everyday speech.

The focus of engineers continues to be on larger storage capacity, faster data transmission, smarter broadcasting and greener engineering. Just in terms of data storage, most of us are only now poised to think in terms of terabytes and petabytes. Data transmission rates of gigabits-per-second will give way to terabits-per-second too. What other technological advances will change the way we live, work and speak? Let us take a moment to examine some of the hot, new broadcast technologies and, of course, the associated terms we will hear, and use, now and in the future.

WHERE DO YOU COME FROM?

The English language is in a constant state of evolution. Many words common in the 1800s and 1900s are no longer considered useful in 21st century. According to the Global Language Monitor, there are approximately 1-million words in the English language. A personal vocabulary of 7,500 words is considered to be necessary in order to write and speak fluently today. As you can guess, there are many words in use today that will cease usefulness as others find their way into our every day usage. While a spittoon is certainly not 'in vogue' any more, when was the last time you heard someone ask for an ash tray? Sure, these are not technical terms, but they have seen their day. When was the last time you heard someone talk about dropping a needle on a record? If you are like most, it has been a while.

Let us take a moment and examine the word 'radio.' We have all been touched by this technology throughout our personal lives and throughout our careers. Radio was originally called 'wireless telegraphy' and was shortened to 'wireless.' The word 'radio' was first used in 1897 by French physicist Edouard Branly when he wrote about radioconductors. The term 'radio' is based on the Latin word 'radius' which means 'the spoke of a wheel; a ray of light.' The use of the word 'radio' as we know it today appeared in a 1907 article by Lee de Forest, but creation of the word is credited to a marketer by the name of Waldo Warren. In 1912, the US Navy adopted the use of the word 'radio' and by the time commercial broadcasts began in the 1920s 'radio' became the common word used to refer to the actual transceiver. It is interesting to note that the term 'wireless' has been revitalized and has taken on a new meaning in our lives. One hundred years ago, 'wireless' was used to describe radio, but today 'wireless' is used as a reference to wireless networking and internet connections.

With most professions, there is a fair amount of jargon. Jargon is simply special words that are specific to a profession, group, or activity. If you sail, you would likely be familiar with jargon like jib, halyard, and leeward. If you are a philatelist, or stamp collector, terms like perforations, hinges, and possessions take on new meanings. Computer related jargon continues to grow as technology improves and the needs of users change as quickly. Can you remember the first time you heard of Microsoft Vista or XP? At first, they were strange, but by now, most of us use them as commonplace terms.

According to the Global Language Monitor, the most commonly used jargon in the world is the term "O.K." If you remember your history lessons, O.K. is the abbreviation for Old Kinderhook; this was the nickname of our 8th President, Martin Van Buren. Kinderhook is a direct reference to the town of his birth in New York. In Van Buren's 1840 campaign for re-election, his slogan was 'Martin Van Buren is O.K'. Today, the term 'O.K.' is synonymous with 'all is well.'

In their 2007 list of the '10 Most Confusing Yet Frequently Cited High Tech Buzzwords' the Global Language Monitor published the following list:

1. *iPOD* - Apple's portable media player.

2. *Flash* - As in memory; also software from Adobe.

3. *Cookie* – Package of text sent from a server to a web browser then sent back each time the browser accesses that server.

4. *Nano* - Smaller version of Apple's iPod.

5. *Kernel* - Central component of most computer operating systems.

6. *Cell* - As in cell phone and being within a cell in order to use a cell phone.

7. *Plasma* - Video display technology; more on this in a moment.

8. *De-duplication* - Similar to data compression, but looks for redundancy of very large sequences of bytes across very large comparison windows. The first stored version of a sequence is referenced instead of being stored again.

9. *Blu-Ray* – One of two primary DVD formats for high definition video playback; HD DVD is the other format. More on these in a moment.

10. *Megahertz* – In computing, it refers to the clock speed of the central processing unit; it is the electrical voltage that changes from low to high and back again at regular intervals.

As a matter of reference, here are some of the words that made their list in 2005:

- HTTP
- Voice Over IP (VoIP)
- Megapixel
- Plasma
- Robust
- WORM
- Emoticon

STORAGE

In 1991 I purchased my first desktop computer for home; it was a Packard Bell with a 286 megahertz (MHz) processor that included a whopping 40 megabyte hard drive for storage space. By today's standards, this is laughable, but it does give us some perspective of how far we have come in relation to standards for storing data. Fifteen years ago we were talking in terms of tens and hundreds of megabytes (MB); in 2008 we are already to leave thoughts of gigabytes (GB) behind and start using terabytes (TB) and petabytes (PB) as our every day terms of data storage. As technological advances reduce the cost of storage and the demand for more space rises, we have been witness to the inclusion of terms like 'bits' and 'bytes' into practically every language on the globe, but also the inclusion of terms like kilobyte, megabyte, gigabyte and terabyte as these storage levels are incorporated into everyday life at home and at work.

While terabytes and petabytes are working their way into everyday use, it is apropos that we look at storage from the bit up to the

yottabyte. For most, this will simply be a review of data storage and the terms associated with specific amounts of data, but it does offer a perspective of how much data is stored at what levels.

A bit is the basic form of data upon which all others are built. A bit can be one of two digits; a 0 or a 1. As a binary digit, a bit is not only the basis of all digital communications but digital storage. Data transfer rates are usually described in terms of bits per second (bps), but for the sake of this discussion, we will focus on the use of bits as storage units. When stringing a series of bits together, we achieved a byte. When first used, a byte was made of various strings of bits, but it is generally accepted that eight bits comprise one byte. For those of you that prefer, a byte can also be referred to as a word.

As documents and programs grew, the size of the multiples of bits and bytes needed over time also grew. When a thousand bytes of space was needed on a hard drive, this was one kilobyte (KB). As demands for greater storage arose, devices capable of storing megabytes, or thousands of kilobytes were produced. One thousand kilobytes brought us to the level of one megabyte; one thousand megabytes hit one gigabyte while a thousand gigabytes is one terabyte. One terabyte (1 TB) hard drives are readily available today though all the major electronic retailers for only a few hundred dollars. Companies like Cisco are already working with storage in terms of petabytes, or roughly 1-quadrillion bytes for each petabyte. In 2005, Cisco's storage for their Marketing, Sales and Human Resources departments was over 2-petabytes; last year it increased to 11-petabytes. How long before Cisco is dealing with storage area networks with a combined total of exabytes or more? The following list shows the storage sized and the associated terms that we will all come to know sooner or later.

- 1 Kilobyte (KB)
  or one thousand bytes
  or 1,000

- 1 Megabyte (MB)
  or one million bytes
  or 1,000,000

- 1 Gigabyte (GB)
  or one billion bytes
  or 1,000,000,000

- 1 Terabyte (TB)
  or one trillion bytes
  or1,000,000,000,000

- 1 Petabyte (PB)
  or one quadrillion bytes
  or 1,000,000,000,000,000

- 1 Exabyte (EB)
  = one quintillion bytes
  = 1,000,000,000,000,000,000

- 1 Zetabyte (ZB)
  = one sextillion bytes
  = 1,000,000,000,000,000,000,000

- 1 Yottabyte (YB)
  or one septillion bytes
  or 1,000,000,000,000,000,000,000,000

WiMAX

WiMAX is not necessarily something many of us are anticipating but it does have the capability of changing much of what we do in our daily routines. WiMAX enables the delivery of last mile wireless broadband access as an alternative to wired broadband like cable and DSL. WiMAX provides fixed, nomadic, portable and, soon, mobile wireless broadband connectivity without the need for direct line-of-sight with a base station.

In a typical cell radius of two to six miles, WiMAX systems are expected to carry up to 40 Mbps per channel, for fixed and portable access applications. This is literally enough

bandwidth to support hundreds of businesses with T-1 connectivity simultaneously and thousands of residences with DSL-equivalent speeds. WiMAX on a mobile network should provide up to 15 Mbps of capacity within a typical cell radius. WiMAX is also expected to become part of a standard load on laptop computers allowing for urban areas and cities to become "metro zones" for portable outdoor broadband wireless access.

To summarize, the bandwidth and reach of WiMAX make it suitable for the following potential applications:

- Connecting Wi-Fi hotspots with each other and to other parts of the Internet.
- Providing a wireless alternative to cable and DSL.
- Providing high-speed data and telecommunications services.
- Providing a diverse source of Internet connectivity as part of a business continuity plan. That is, if a business has a fixed and a wireless Internet connection, especially from unrelated providers, they are unlikely to be affected by the same service outage.
- Provide connectivity wherever you go.

Will WiMAX be the 'killer ap' that closes the books on satellite radio? Doubtful, but it could provide more competition to the likes of Sirius and XM Radio. Only time will tell.

RADIO GOO GOO

HD radio is here! The FCC's Second Report and Order on DAB issued in 2007, made it possible for broadcasters to begin FM In Band On Channel (IBOC) multicasting and Extended Hybrid operation without permission or notice. Additionally, it allowed for AM IBOC broadcasting at night. IBOC gives stations the capability of being able to transmit digital and analog radio signals simultaneously on the same frequency. Needless to say, HD Radio has swept the US and is now available in all major radio markets. As of early 2008, Ibiquity.Com showed North Dakota as the only state without HD radio broadcasts. iBiquity Digital developed HD Radio technology and has helped changed how we listen to radio with more channels, improved sound quality, and new services. Look for more signs this year on the use of IBOC for datacasting for businesses. Other competing formats included FMeXtra and Digital Radio Mondiale (DRM).

Created by Digital Radio Express, FMeXtra uses subcarriers within the existing signal and therefore allows stations to use exiting equipment too. With FMeXtra, there is also no royalties to pay. A recipient of Radio's World's 2007 Cool Stuff Award, Digital Radio Express' Aruba FMeXtra Receiver handles both analog FM broadcasts as well as FMeXtra digital programs. The other competitor for digital broadcasting is Digital Radio Mondiale (DRM), developed by a non-profit global consortium. DRM is designed to work over the AM broadcast bands and provides great gains in audio quality for shortwave broadcasters. With the use of MPEG-4 codecs, DRM can fit more channels at a higher quality into a given bandwidth.

A TELEVISION OR A MONITOR?

When discussing the purchase of a new television or monitor for computer work, we are invariably talking of flat screens these days. Sales of LCDs and plasma displays have skyrocketed leaving the older cathode ray tubes in a waning position in the 'new purchase market.' In 1976 I worked in a personnel department in New Mexico where we processed data by typing information into computer terminals connected to a mainframe computer that was located in another building. The terminals were similar to old teletype machines where the data was typed onto a wide roll of paper and each character was

placed there with a loud CLACK. We also used IBM cards to update low-priority data overnight along with long reels of paper tape; all with holes punched into them representing specific information.

In time these gave way to the use of a television-like screen called the cathode ray tube, or CRTs. In the late 1970s, CRTs were the greatest thing to hit our profession as we dropped the use of paper and cards for displaying data and simply let the new system display the information on a monochrome CRT.

Originally designed in 1897 by German scientist, Karl Braun, the CRT consists of a vacuum tube and an electron gun. The electron gun works at right angles with the fluorescent coating on the inside of the television tube. The gun generates a beam of electrons that moves back and forth and when the electrons from this beam strike the phosphor dots that are on the inside of the tube, they light up and create the active sections of the screen. All these active sections together create a complete image as the beam draws a complete set of lines from the top to the bottom of the television screen. The technology is still employed by many televisions and computer screens still in use today, but that is changing. Many people are opting to give up their CRTs for flat liquid crystal display (LCDs) monitors, and in some cases, PDPs, or plasma display panels.

The concept of using liquid crystals dates back to 1888, but it was in 1972 when the first LCD was produced in the United States. If retail sales numbers for the 2007 holiday season are any indicator, LCD displays have alredy replaced CRTs as the preferred standard for new televisions. While there are definitely advantages to using LCD monitors, they do have their drawbacks:

- When hooked to a computer, LCDs produce sharp images only when using their native resolution (when the input matches the native resolution, the LCD produces its optimal display); CRTs are capable of displaying multiple video resolutions without producing any noticable artifacts. Some resolutions work well, however, if they are exact multiples of smaller image sizes. For example, a 1600×1200 LCD will display an 800×600 image well, as each of the pixels in the image will be represented by a block of four on the larger display, without interpolation. Since 800×600 is an integer factor of 1600×1200, scaling will not adversely affect the image. As of early 2008, only the very best LCDs can approach the contrast ratios of plasma screens while most LCDs still lag behind.

- LCDs typically have longer response times than CRT and plasma displays. LCDs experience ghosting when images quickly change. For example, when moving the mouse quickly on an LCD, sometime you will see multiple cursors.

- LCDs have a limited viewing angle when conpaired to CRTs and PDPs. The overall effect of this shortcoming is that fewer people are able to view the same image; most laptop computers suffer from this problem. While fewer people can view an LCD display, it does require less power thus extending the life of the batteries and reducing the overall consumption of electricity.

- LCD monitors usually break easier than CRTs, especially since the screen of the LCD display lacks the thick glass front so common on CRTs.

Plasma display panels were invented in 1964 and began as monochome units. They are flat panels that we normally see used for large video displays. The cells of a PDP are held between two plates of glass contain a mixture

of neon and xenon gases. The mixture changes into plasma when the cells are exposed to electricity; this activates the phospors causing them to emit light. While a PDP provides crisp pictures, there are also issues with the use of a PDP:

- Over time a PDP can suffer from burn-in. The problem is that the phosphor compounds used for producing light lose their luminosity with use. If a PDP is used for a computer program and is constantly powered to display information, over time areas become visible and do not go away, even after powering off the PDP.

- The quality of the images displayed will gradually decline over time reducing the sharpness and clarity of the picture.

- When groups of pixels are forced to display high light levels, especially white, for long periods, this can create an image on-screen that will remain viewable until the power is cycled on the PDP or after running some random display on the PDP.

Since their early days though, makers of PDPs have develolped ways to reduce the problems of image retention through the use of image washing protocals, and pixel orbiters.

One technology that has yet to take off until recently is Laser TV. Last year there was some talk about laser television but nothing ever came of it. Laser TV is a projector technology using lasers instead of incandescent lamps to create light. Those that support Laser TV say it uses less power and allows for lighter sets than even LCDs offer, with "bulbs" that never burn out. It was in early 2006 when reports on the development of a commercial Laser TV were first released. At the Consumer Electronics Show (CES) 2008, Mitsubishi unveiled their first commercial Laser TV; it is a 65-inch model that is fully HD capable. The reviews from those that were able to view the Laser TV were good. Those that saw the clips from popular movies felt the color was phenomenal, but also to the point of looking artificial. Laser TVs are expected be on sale in time for the 2008 holiday season. On a final note, China's SYCO demonstrated a 120-inch Laser TV in 2007 which is the world's largest to date.

Whether using a desktop computer or a laptop today, the majority of the world still relies on a visual display of data through the use of some type of electronically powered screen or display. One final note, the world's largest plasma display is currently a 150-inch unit made by Panasonic and was one of the many new innovations shown earlier this year at the 2008 Consumer Electronics Show (CES); standing 6 foot by 11 foot, it is expected to initially retail for $150,000. This behemoth easily overshadows the 108-inch LCD that was unveiled at the 2007 CES by Sharp.

The choices are there, one only need compare prices and determine what is best for you. For my money, I still prefer the Sony Trinitron E540 21-inch CRT for my computer work at the office and at home.

VIDEO GA GA

In the global competition for high definition video playback, there have been two main competitors: Blu-ray and HD DVD. Consumers that stay on the leading edge of technologies are helping drive the market people that purchase cameras with ever higher megapixels though they fail to notice any difference a picture taken with the new camera when compared to an older camera capable of fewer megapixels. Why does anyone care about high definition DVD formats? One reason is that the two standards are incompatible. Eventually, one of the two would have to fall while the other inherited the DVD legacy. Earlier this year, Warner Home Video announced that it was dropping

support for the HD DVD format and would release future video products only in Blu-Ray. This is considered a major win for companies like Sony who backed Blu-Ray; Sony included Blu-ray playback in its PlayStation 3 entertainment system. While there are winners in this competition, there are losers too. For example, Microsoft chose to provide HD DVD capability in its Xbox 360 gaming systems. Another was Toshiba who reacted to Warner Home Video's announcement by slashing the prices of their HD DVD players in an effort to attract new users to the HD DVD format.

Not Your Parent's Google

Earlier this year, Truveo, the leading video search engine, announced that its index had exceeded 100-million online videos. With their current growth rates, Truveo expects their index to reach one billion searchable videos by 2009. Since 2004, Truveo has operated one of the most comprehensive video search engines By way of illustration, if each on the Internet. Truveo's search engine continuously searches the Internet tracking videos that have come online. Is Truveo the same as YouTube? Likely so in many ways. YouTube was created in February 2005, as a 'consumer media company' for people to search for, watch and share original videos worldwide using the Internet. YouTube was purchased by Google in October 2006. Though YouTube and Google have a large inventory of videos, they only search themselves while Truveo also searches YouTube and Google.

Analog To Digital

Let us take a look at the pending demise of analog television scheduled for February 2009. The allotted spectrum used to broadcast television is granted by the government. In 1996 it was doubled so a station could have analog and digital transmissions. The spectrum freed up by the loss of analog signals will be auctioned off while the rest will be used for national security and emergency communications.

If you still have an analog TV set, you will also need a converter box to receive a digital signal but view it in an analog world. Converter boxes will be less than $100 each. Since a digital broadcasts are better than analog, you would think everyone would be all for this move, but that is not so. To encourage the transition of our fellow citizens, the government is providing an incentive in the way of two $40 coupons to be used towards the purchase of digital-to-analog converter boxes. The boxes are only necessary for anyone viewing over-the-air broadcasts; if you pay a monthly subscription to a provider, they converter boxes are unnecessary. One only needs visit www.dtv2009.gov to request the coupons and take a major step to enjoying a world full of digital television signals.

Most of us will buy a digital TV soon if we do not have one already. The best selling TVs are those capable of high definition TV (HDTV). In the United States, HDTV displays are 720p, 1,080p and 1,080i. These numbers tell you how many lines of information the signal holds. The "p" stands for a non-interlaced progressive scan. With progressive scanning, the lines displayed on your TV appear smoother to the eye. The letter 'i' in 1080i stands for interlaced or non-progressive scan. The numbers 720 and 1080 stands for the number of lines of vertical resolution. With HDTV, we assume we are viewing a widescreen aspect ratio of 16:9, implying a horizontal resolution of 1920 pixels and a frame resolution of 1920 x 1080 or just over 2-million pixels; the same applies to 1080p.

One lesson we learned in our family about 2-years ago is that if you have an HDTV, it does not mean you are watching HDTV programming. You must ensure you are also receiving an HDTV signal too. Besides the over-the-air option for HD programming, most cable and satellite providers, along with

many phone companies, like Verizon, will gladly provide you this programming as long as you are willing to pay extra for HD programming.

If you have seen the DirecTV commercials with Jessica Simpson, then you have heard of 1080i. How many really know what 1080i is? When Ms. Simpson encourages you to buy a DirecTV high definition (HD) system, it is all about the quality of high-definition television. In Jessica's words, "Hey, 253 straight days at the gym to get this body and you're not going to watch me in DirecTV HD? You're just not going to get the best picture out of some fancy big screen TV without DirecTV. It's broadcast in 1080i. I totally don't know what that means, but I want it." I think this is true for most consumers; we're not sure what it is, but we do know it is better than normal TV and we want it!

High Definition Multimedia Interface

According to the official HDMI website, www.HDMI.com, it boasts of "one cable – one standard." They tout HDMI as "the future ready way to connect HD." HDMI stands for high definition multimedia interface. HDMI provides a simple-to-use interface between any audio/video source, such as a set-top box, DVD player, or A/V receiver and an audio and/or video monitor, such as a digital television (DTV), over a single cable. You can still find systems that simply use three RCA cables to bring in two channels of audio and the video feed, but that is changing quickly.

HDMI states their standard "supports standard, enhanced, or high-definition video, plus multi-channel digital audio on a single cable. It transmits all ATSC HDTV standards and supports 8-channel, 192kHz, uncompressed digital audio and all currently-available compressed formats (such as Dolby Digital and DTS), HDMI 1.3 adds additional support for new lossless digital audio formats Dolby® TrueHD and DTS-HD Master Audio™ with bandwidth to spare to accommodate future enhancements and requirements." HDMI has become the standard digital interface for high definition television.

HDMI is also the interface being used to join computer and consumer electronics devices. The advantages of HDMI over existing analog video connections like S-Video, composite, and component video is that it provides quality signals, it is easy to use and it is HD ready.

FINALE

There are many terms like gigabyte and terabyte we use regularly and without hesitation. While this was an overview of some terms we use and some that may find their way into our daily lives, we have only scratched the surface. As we continue to improve operations through larger storage capacity, faster data transmission, smarter broadcasting and greener engineering, we will certainly adapt new words to our vocabulary just as we have in the past.

The challenge for engineers is to stay abreast of technologies as they change and affect us. We also know that it is impossible to stay 'on top' of everything. You can still keep ahead of the game by attending the NAB as often as possible, continually reading professional publications and email lists, and communicating with your co-workers and peers. Good luck!