PROVIDING MEDIA-RICH CONTENT USING DIGITAL RADIO

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Introduction

• Digital radio data services have the capability to deliver new revenue streams to broadcasters.

• By enhancing digital radio broadcasts with synchronized visual content as data services, it is possible to present media-rich content to the user.

• Broadcast radio offers a ubiquitous, low cost data transport medium for advertising and information on personal devices as well as public displays and electronic signage.

• We’ll discuss the principals, systems, protocols and applications required to present graphical content and other data services through enhanced digital radio broadcast transmission and receiver platforms.
Background

- Digital Radio Broadcasting (DRB) is the generic term for all digital radio systems, in development since the mid-1980s as a more efficient digital replacement for traditional analog FM broadcasting providing multiple audio and data services on a single frequency.

- Eureka 147 based Digital Audio Broadcast (DAB), and more recently DAB+ and Digital Multimedia Broadcast (DMB), systems have been developed and introduced in Europe, Canada and Australia on Band III (174-230 MHz), formerly used for analog television signals. Other countries such as Germany and Canada are using L-Band (1452-1492 MHz).

- In the United States and other countries, the desire for a more gradual digital transition and the unavailability of other spectrum has lead to the development of in-band, on-channel (IBOC) digital radio technology. IBOC allows stations to transmit digital audio and data services within their allocated channel while maintaining the current analog signals in Band II. HD Radio™ is the IBOC technology developed by iBiquity Digital Corporation which was selected by the FCC in 2002 as the digital audio broadcasting standard for the US.

- Another IBOC technology standard currently under development for DRB is the Digital Radio Mondiale (DRM) developed in 2001 by a consortium of French broadcasters and manufacturers originally for Short and Medium Wave transmission. DRM+ developed in 2007 extended the DRM standard to the broadcasting bands between 30 and 174 MHz; primarily Band I (47 to 88 MHz) and Band II (88 to 108 MHz).

- As this discussion is primarily intended for US audiences, we will focus the remainder of the discussion on the US and HD Radio.
Commercial Considerations

- Multimedia enhanced radio services can provide direct revenue streams or may simply enhance the broadcaster’s brand
  - Adding a multimedia dimension to radio broadcasts enhances the value to the listener by providing a new level of user experience.
  - Revenue streams may be enhanced by graphical advertising and product coupon offerings.
  - Multimedia subscription services such as location-based traffic and Journaline™ are already generating revenue for some broadcasters.
  - Conditional Access may provide additional revenue streams for these enhanced services
Commercial Considerations

- **Point-of-sale advertising and billboard models can provide additional revenue streams by leasing multimedia data capacity**
  - Utilizing DRB data streams as a transport medium, content may be directed to designated receivers driving digital signage systems.
  - Could be used by broadcasters for promotional branding at station remotes and public events.
  - This model is currently being explored using the Harris InfoCaster™ digital signage system.
Digital Multimedia Functionality

- DAB, has well defined data and multimedia applications based on open standards that have been implemented for some time

  Album Art / Slideshow
  Ad Tagging
  Traffic Services
  Journaline®
  Electronic Program Guide

- Standards lend themselves well to the other DRB systems.
- Application Program Interfaces (APIs), within the HD Radio system transmission and receiver ecosystems accommodate these functions
- Software development kits are available for third party developers to create their own specific HD Radio multimedia applications
Album Art

- **Album Art** is a derivation of the DMB Slideshow application which provides digital radio broadcasts with visuals using standard web image formats.

- Standard Resolution: 200x200
- Formats: JPEG, PNG, (GIF)
- Target File Size: 10-12k
- Max File Size: 24k
- Supports both synchronized and non-synchronized images
- Delivered as LOT objects tied to audio program through Program Service Data XHDR tag.
- One data service provides all images for a given station.
- Ability to identify copyright vs non-copyright images

- Station Logos supported with unique service identifier

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Now broadcasters can show actual album cover art as well as artist and title.

Station logo or similar graphic displays when no appropriate visual available.

Provide valuable visual product information.

Broadcast system software upgrade to support synchronized images and station logos rollout is June 2010.
iBiquity provides a Software Development Kit (SDK) for receiver partners to aid feature integration.
HD Radio Ad Tagging

Working with industry partners to extend tagging capability to connect listeners with advertisers and promotions. Ad-iD is the meta-data standard for ad creative in the USA.

Some Advertisers Using Ad-iD

- Kellogg's
- P&G
- Microsoft
- Sears
- Toyota
- Liberty Mutual
- Novartis
- Foot Locker
- Curves
- Honda
- Embraer
- Johnson & Johnson
- Nisshin
- Samsung
- Capital One
- Sony
- AirTran
- L.L. Bean
- Activation
- Toys"R"Us
- Sony
- Smith Barney
- Campbells
- Chico's
- IKEA
- Petsmart
- Discovery
- Afisco
- Sony

Ad-ID Web Services & Roles

- Meta-data fields auto-populate based on Ad-ID Code and data received from Ad-ID Web Services
- Ad-ID gets integrated into digital file
- Digital file with Ad-ID Code and data can be checked against Ad-ID metadata populated in systems via web services
- Metadata field for use in digital and digital asset management systems

NON-VISUAL MEDIA

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VISUAL MEDIA

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Mobile Data Services

Traffic

- Total Traffic+ HD Network
- Clear Channel Radio
- NAVTEQ Traffic Digital
- BTC Broadcaster Traffic Consortium

- Weather
- News
- Sports Scores
- Stocks
- Fuel Prices
- Movie Times
- Airport Delays

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International Data Standard for Traffic

- Traveler Information Services Association accepts HD Radio Technology as digital broadcast ‘bearer channel’ for delivery of services to automotive and navigation platforms.

- Global TPEG standard for:
  - Traffic data
  - Incident information
  - Flow data
  - Parking, weather, fuel prices, etc.
  - Conditional Access Technology
Premium Services - Total Traffic

Real-Time Traffic: Flow & Incidents
- The increased coverage from roadway sensors provides more accurate traffic data.

Predictive Traffic Flow over TFP
Leveraging patented algorithms and methods, INRIX uses real-time flow and incident data as well as forecasts of weather, events, school calendars, etc., to forecast traffic conditions for specified times in the future and are reported for 15 minute road segment level.

News Headlines
Key news headlines on an overall basis and by topic. The feed is based on standard news category descriptions, but a specific topic proves to be valuable, we will work to include headlines of the top stories, top 5 stories for each topic.

Weather: Doppler Radar Image
Provide tiles that enable an overlay of Doppler radar on top of a map image. One tile per metro/market with 320 x 240 PNG8 (plus Alpha layer) to show current precipitation conditions and radar image per metro/market according to NOAA.

Weather Conditions & Forecasts
Provide current weather conditions and forecasted weather conditions for the metro/market on a market-by-market basis. Within each market, we first define the major and minor states and the current and 5 day forecast data: weather, including conditions, temperature, precipitation probability and wind speed.
Premium Services – BTC Traffic

Service launched and supports 80 metropolitan areas in North America
Real-Time traffic, weather, and fuel content supported
Drive testing software and hardware are available for content and coverage evaluation
BTC broadcast partnerships have expanded to 16 members including pan-Canadian broadcaster
Electronic Program Guide

• **Electronic Program Guide (EPG)** offers users the ability to navigate, select, and discover content by time, title, channel and genre from an onscreen graphical program guide.

• EPG is well developed and widely in use for DAB throughout the UK. Digital radio broadcasting in the U.S. will benefit substantially by deploying an EPG system.

• iBiquity has developed an EPG data structure and client application specifically for HD Radio.

• Development and field trials of the overall EPG ecosystem for U.S. radio broadcasting are now underway with funding and management provided the NAB FASTROAD program.
Premium Content Services

Targeted Data Services

- Accent
- Sonata
- Genesis
- Tucson
- Santa Fe
- Veracruz
- Elantra
- Axxera
- Tiburon
- Entourage

Opt-in Adult Programming

Concerts and Sports Programming

- ESPN Radio HD
- NDS RadioGuard™
Premium Services - Journaline

- **Journaline** is an international standard for the transmission of text-based information via digital broadcasting systems, including HD Radio, developed by German research institute Fraunhofer IIS.
- Supports a metadata option for text-to-speech playback, as well as geo-referencing to help localize information.
- Menus and text are encoded in JML (Journaline Markup Language) a binary representation of XML formatted content. Pages are restricted to a maximum size of 4 KB.
- Total Traffic Network is adding Journaline to its digital radio service in the United States.
- Decoder implementations are available for licensing through Fraunhofer IIS making them easily adapted into the HD Radio receiver host processor.
Premium Public Radio Services

Public radio stations can deliver new programs to members and provide new services to the visually impaired.

Supporting the development and deployment of Premium Content services for network of +600 NPR station affiliates
Push Radio

- Commercial Radio Australia and Beijing Jolon Digital Media Broadcasting are developing and promoting a new technology that will allow podcasts to be sent via the DAB+ broadcast band.
- The “Push Radio” application is based on the European digital radio system DAB+ and will be developed further as part of an agreement between Beijing Jolon and Commercial Radio Australia.
- Frees listeners from the necessity to connect to the internet to receive podcasts, targeted programming and other specific information
- Push Radio will make a podcast even more accessible for all digital radio listeners
Radio DNS

• Connected radio devices are everywhere

• Radio and internet in one box
Data Transmission Architecture

- Audio and data are presented to the Importer API by separate audio and data client applications, while separate data client applications supply the data services.
- Audio is encoded and compressed by the HD Codec (HDC).
- All data (including PSD) for AAS is encoded via the Importer’s Radio Linking Subsystem (RLS).
- All data (including PSD) for MPS is encoded via the Exporter’s Radio Linking Subsystem (RLS).
- All data services are asynchronous with the audio.
- The Importer multiplexes all of the Advanced Applications Services (AAS), supplemental audio (HD2, HD3 etc) and data services into a single Importer to Exporter I2E IP stream for transport to the Exporter.
- The Exporter requests and receives data synchronously from the Importer via the I2E data link where the multiplexed AAS data from the Importer is then re-multiplexed with the encoded Main Program Service (MPS) (HD1) audio and PSD data.
- The HD Radio stream is sent asynchronously from the Exporter to the Engine as the E2X IP transport stream for low level modem processing onto the OFDM waveforms, ready for up-conversion to the final on-channel frequency by the rest transmission system.
Data Transmission Architecture
Bandwidth Allocation

- Bandwidth configuration and management is handled by the Importer’s Administrator.
- The HD Radio stream can carry four streams of digital audio.
- Theoretically the number of data streams is only limited by the available bandwidth.
- Up to 64 kilobits/sec for additional audio or data services is available in MP1 mode.
- An additional 24 kilobits/sec data on the P3 channel partition in MP3 mode.
- **PARTITIONS CANNOT BE USED CONTIGUOUSLY**
- Each configured service must be assigned to, and fit within, the assigned P1 or P3 partition. (Except FlexPacket)
Example: With a 46 KB/S HD1 (MPS) AND A 46 KB/S HD2 SERVICE AND FOUR 1 KB/S DATA SERVICES CONFIGURED TO PROVIDE TWO STREAMS OF ALBUM ART (ONE FOR EACH AUDIO SERVICE), A TRAFFIC SERVICE AND AN EPG SERVICE

- TEN FILES OF 10 KILOBYTES EACH THAT NEED TO BE DELIVERED ON A SINGLE STREAM
  - Each service has 1 KILOBIT/SECOND allocated
  - 10 KILOBYTES X 10 FILES * 8 BITS/BYTE - 800 KILOBITS
  - IT WILL REQUIRE 800 SECONDS OR ABOUT 13 MINUTES TO DELIVER ALL OF THE FILES TO THE RECEIVER
  - If faster delivery and/or larger file sizes are needed, more data bandwidth can be allocated to the data services at the expense of audio service bandwidth. Bandwidth management for audio and data is handled by the Importer’s bandwidth manager and is configured in the Importer Administrator.
Data Transport Methods and Protocols

• In the HD Radio system all data services share a common protocol: Radio Linking Subsystem (RLS).
  – RLS uses a dynamic port numbering method to distinguish the various services sharing the station’s bandwidth.

• There are four underlying transport protocols used to encode the data received from a data client prior to application into the RLS transmission stream:
  – Standard Packet
  – Flex Packet
  – Byte Streaming
  – Large Object Transfer
Standard Packet

- Encapsulates a predetermined set of bytes received from the client as an individual “Packet”
- Frees the application from performing any segmentation and reassembly
- Importer’s bandwidth manager assures that each data client receives the allocated bandwidth
- No guarantee of bandwidth for each frame and no guaranteed arrival time
- Data clients must limit packet size to no greater than the capacity of the Program Data Unit (PDU) in which it is to be carried.
- The Standard Packet transport is best suited for non-real-time applications and file transfers where the file sizes are known and packet encapsulation is fixed by the originating application.

- The P1 channel PDU rate is ~1.486 seconds while the P3 channel PDU rate is ~0.186 seconds.
- A data client with a bandwidth allocation of 1 kbps is limited to a packet size of: (1000 bits/sec) x (1 byte/8 bits) x (1.486 sec/PDU) or ~185 bytes on the P1 channel.
- On the P3 channel the same service is limited to a packet size of: (1000 bits/sec) x (1 byte/8 bits) x (0.186 sec/PDU) equaling ~23 bytes

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<td>1.486 Seconds</td>
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<th>P3 Logical Channel - MP3 mode only</th>
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<td>0.673 PDU/sec – Frame Rate PDU – 96 Kb/s</td>
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<th>5.38 PDU/sec – Block-Pair Rate PDU (x 8) – 24 Kb/s</th>
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<th>P1 &amp; P3 Logical Channel PDU Rates</th>
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Flex Packet

• Lifts the packet size restriction
• Can allocate very little bandwidth and maintain packet structure independent of logical channel
• While Flex Packet file is being delivered, all other Flex Packet services on that logical channel must wait until the entire file has been delivered rendering file delivery unpredictable
• The Flex Packet delivery method is best suited for non-real time applications where delivery timing is not critical.
Byte Streaming

- Client applications must perform segmentation and reassembly
- Simply accepts bytes from the client as they arrive
- Transmission system decides how best to break them up into frames based on the allocated bandwidth
- Each stream is guaranteed bandwidth and time-of-arrival for each frame
- Most appropriate for applications requiring near-real-time performance
Large Object Transfer

- Similar in function to the DAB Media Object Transfer (MOT) protocol
- Allows transfer of large data objects of any type
- Breaks large objects into multiple packets containing fragments of the original object
- Uses either the Packet or Flex Packet methods with a nominal packet size of 256 bytes
- Receiver must contain LOT decoder to reassemble packets
- The LOT application can manage lists of files to be transferred and the protocol offers other features such as multiple transfers, discard times, content identification, and error protection.
- LOT is the recommended method for broadcasting images
Synchronization of Media with Audio

• There is no provision for synchronization of the program audio services with the data services inherent in the HD Radio system. When transferring images, the difference between the packet delivery methods can dictate how far in advance of the associated audio the image must be sent to insure it is available for display when the associated audio arrives.

• **System Timing**
  – All systems delays are known and can be expressed in terms of the ALFN deltas among the various components. The Importer calculates the number of bytes/PDU allocated for the service along with PDU rate. With this information a value can be calculated as to when the data client application needs to start transmission of a particular image for on-time arrival.

• **Binding Audio and Data Services**
  – Accomplished through registration of the services in the Importer, transmitting that binding information to the receiver via the SIG channel which identifies the required application MIME type.

• **Triggering**
  – Presentation time of each image is accomplished by including a custom ID3 tag transported with the other PSD information in a special “XHDR” tag. The receiver executes a command to display a specific file along with the audio content.
Basic HD Radio Data Receiver Architecture
Inside the Zune HD

- Host / Broadband Processor board
  - Hynix H5MS1G2MFP
  - Low Power Mobile DDR SDRAM,
  - NVIDIA Tegra APX2600-HM-A3
  - Applications processor with a 600MHz ARM-11 core.

- Siport SP1010LN HD Radio® Baseband Processor/Controller
- Toshiba NAND flash memory.
- The smaller silver chip with the EMI shield is an Atheros AR6002 responsible for Mobile Wi-Fi.
January 2010, Cypress, Calif. — JVC introduced the KW-NT3HDT, the first commercially available in-dash all-in-one memory navigation system with built-in **HD Radio®** to support Album Art, Journaline and Total Traffic Network Plus in-vehicle applications.

**Other features include**
- Windows Automotive OS
- iTunes Tagging
- Bluetooth® Wireless Technology
- iPod®/iPhone™ audio and video playback
New HD Radio Receivers

$69.00

www.mightyredhd.com
• **Artist Experience** - Now you receive images related to the songs you are listening to. Album cover art, photos of your favorite artists in concert, or during a visit to the radio station, etc. (Artist Experience not initially available in all markets.)
• **Live Pause** - Allows you to pause the radio for up to 15 minutes, then come back to hear what you've kept.
• **Bookmark** - Like a song you are listening to, but are not certain what it is? Simply bookmark the song title and artist's name for later reference. You can bookmark up to 20 items at a time.
• **Capacitive Touch Screen** - No buttons required. Control your Mighty Red 2 by touching the icons on screen.
• **Large four color display** - You enjoy your Mighty Red 2 on a 2.5" x 3" four-color screen.
Other HD Radio Receivers
Conclusions

• This discussion is not intended to be an exhaustive description or “how to” manual but rather, an opening dialog to spur ideas and development.

• The concepts and technology for providing media-rich content over digital radio broadcasting are in place.

• Many pieces still need to come together
  – Business models
  – Application development
  – Technology advancements
  – Receiver penetration

• The stakes have never been higher for the radio broadcast industry to deliver new and exciting experiences to the listening audience.
REFERENCE DOCUMENTS

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• Questions?

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