The Technical Basis of PAIS

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Background of the Personalized Audio Information Service (PAIS) Project

A brief overview of the goals, excerpted from the NIDRR-approved PAIS proposal.

National Public Radio (NPR) proposes to define and demonstrate a Personalized Audio Information Service (PAIS) – a new mainstream system that will automatically assemble a selection of locally relevant, customized audio content from audio information service broadcasts. A PAIS system will combine the established framework of audio information services with the new programming flexibility that is afforded by the HD Radio® system (the U.S. standard for digital radio broadcasting), creating a powerful on-demand media tool that will substantially improve media access for millions of visual- and print-impaired American consumers.

Importance of the problem

Equitable access to information is a fundamental right in the United States[1]. As information continues its migration into digital technologies, the variety of information access portals for sighted consumers will greatly expand. However, for millions of print-disabled (i.e., blind, visually impaired, and reading disabled) Americans, the new information world remains frustratingly inaccessible, experienced only through poorly designed or poorly integrated aftermarket

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[1] Section 255 of the Telecommunications Act of 1996.

HD Radio is a registered trademark of iBiquity Digital Corporation.

technology[2]. Given the growing diversity of digital content delivery methods (e.g. TiVo®, podcasting, and peer to peer file sharing) the digital media world will only continue to grow, creating a widening gulf of access between sighted and sight-impaired Americans.

Americans with print impairments will double over the next three decades.

"The number of print impaired Americans is expected to grow dramatically as 'baby-boomers' reach retirement age…the number of Americans with print impairments will double over the next three decades."

- American Council of the Blind

Approximately 19 million Americans (9% of the population) over the age of 18 currently experience vision trouble (defined as trouble seeing, even with glasses or contacts). As age increases, the percentage of adults with vision troubles increases[3]. Print impairment can be caused by a variety of eye disorders, including diabetic retinopathy, glaucoma, cataracts, and macular degeneration (currently the leading cause of untreatable vision loss and legal blindness in the US)[4]. Other people cannot physically hold or comprehend text. This is often caused by strokes, physical disabilities and learning disabilities such as dyslexia. The number of print impaired Americans is expected to grow dramatically as "baby-boomers" reach retirement age, and it is projected that the number of Americans with print impairments will double over the next three decades[5].

Impact of PAIS on the Target Population

National Public Radio, the International Association of Audio Information Services (IAAIS), iBiquity Digital Corporation and Towson University believe that digital radio technology can provide significant opportunities to people who are visually impaired and print disabled. The importance of designing integrated accessible technology with strong prospects for mass-market adoption within digital radio services and receivers cannot be overstated. By designing technology that is novel

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[2] http://www.loc.gov/nls/technical/patronsurvey2003/analysis.html - "Another common reason for not using a computer is inaccessibility to people with disabilities (30% of non-users)."

[3] Lethbridge-Cejku, M., Rose, D. & Vickerie, J. (2006). Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2004. National Center for Health Statistics. Vital and Health Statistics 10, p. 228.

[4] Bressler, N. M. (2004). Prevalence of Age-Related Macular Degeneration in the United States. Archives of Ophthalmology, pp. 122:564-572.

[5] American Council of the Blind website at http://www.afb.org/Section.asp?SectionID=52&DocumentID=2265 .

and desirable for use by both visually impaired and sighted consumers, we will be able to create disability-friendly mainstream products efficiently and inexpensively, thereby giving ultimate choice to disabled consumers. The activities and outcomes of this project will directly impact how print-disabled consumers can better utilize currently available services, while creating an extensible architecture that can incorporate future information services yet to be deployed.

"By designing technology that is novel and desirable for use by both visually impaired and sighted consumers, we will be able to create disability-friendly mainstream products efficiently and inexpensively."

These goals are directly responsive to NIDRR's mission to fund projects that "use knowledge and understanding gained from research to create materials, devices, systems, or methods beneficial to the target population, including design and development of prototypes and processes."

The greatest opportunity offered by this project is the potential for disabled persons to better access media that their sighted or non-disabled peers can access effortlessly. The ability to personalize information acquisition is growing exponentially, and has outpaced current accessibility systems designed for use by persons with disabilities[6]. We envision that the PAIS will bring enormous value to today's visually impaired and print-disabled population, just as screen-reader technology did for blind and visually impaired computer-users in the 1990's. Developing and deploying accessible technology can enhance job opportunities, informal education, and life-long learning, along with the ability to make more informed decisions about daily life[7].

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[6] *Web 2.0 – A step backwards for accessibility?*
http://resources.zdnet.co.uk/articles/0,1000001991,39284428,00.htm

[7] Owens, J.S. (2006). **"Accessible Information for People with Complex Communication Needs"**. Augmentative and Alternative Communication, September 2006 VOL. 22 (3), pp. 196 – 208

Building the PAIS Infrastructure at the Radio Reading Service

The definition of PAIS tags and how a Radio Reading Service station originates and manages them.

T he essence of PAIS---the atom, if you will---is the XML tags that are transmitted in the Program Service Data of the HD Radio transmission. These tags command and inform the HD Radio receiver when a new RRS program is starting, or when a new category is to be added to the master list of categories, or even alert the listener to an imminent threat to life and property.

The PAIS Tag Structure

The PAIS XML Schema used to define the tags is illustrated symbolically below:
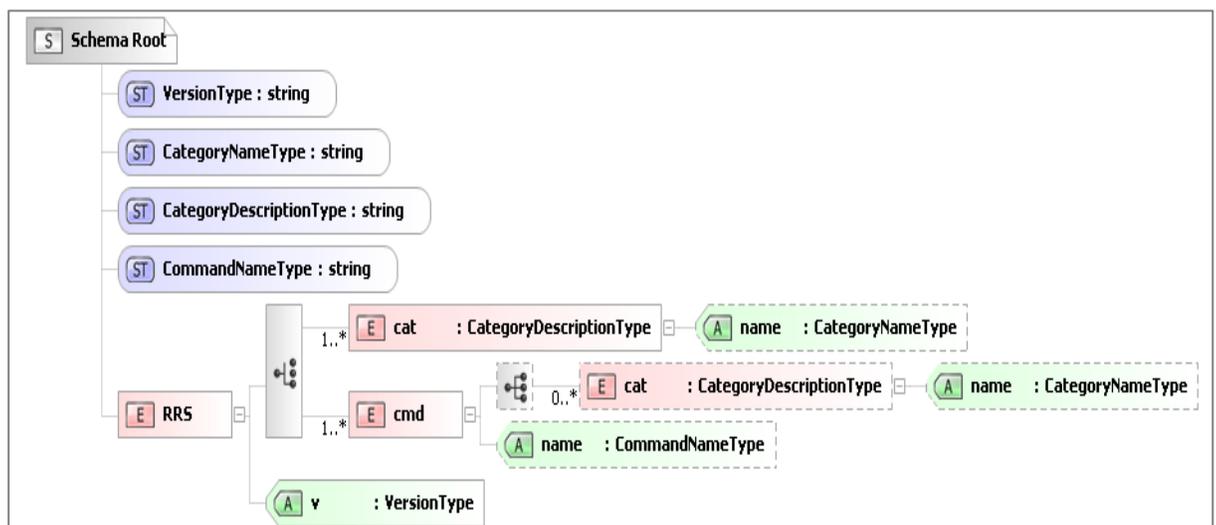
As illustrated, there are two classes of PAIS tag, the "cat" or category, and the "cmd" or command.

PAIS *CATEGORY* TAG STRUCTURE

The following is an example of an actual category PAIS tag used in the PAIS Project:

```
<RRS v="00"><cat name="ABAB">Sports, Local and Regional Newspapers</cat></RRS>
```

Table 1. The tag elements for a typical PAIS "category" tag.

PAIS Tag Element or Type	Description
`<RRS v="00">`	"RRS" denotes this is a PAIS tag. "v" denotes the PAIS tag version.
`<cat name="ABAB">Sports, Local and Regional Newspapers</cat>`	These simple types declare the PAIS tag as class "cat" ("category"). The name attribute is a four upper-case alphabetic character string from AAAA to ZZZZ, which is used to quickly sort and index the categories.
`<cat name="ABAB">Sports, Local and Regional Newspapers</cat>`	A human-friendly description, to be spoken by the receiver and shown on the receiver's display.
`</RRS>`	Denotes the end of the PAIS tag.

When the PAIS HD Radio receives a category tag it performs several checks:

- Is the category already in the receiver's copy of the Master List? If not, this new-to-the-receiver tag is added to the Master List within the receiver.

- Is the category already in the receiver's "MyFavorites" List? If so, close any recording in progress, and immediately begin recording the incoming audio in a new file until the next tag is received.

- Is the category one of three reserved category names, INFO, WARN or EMER? If so, immediately begin recording and alert the user.

Much research has been conducted at NPR Labs into category hierarchy for the user interface and user navigation. In consultation with the International Association of Audio Information Services (IAAIS), a three-tier category structure was created.

In this structure, there are nine top-level categories. The quantity nine maps a category directly to one of the PAIS receiver's expected one-through-nine keypad buttons.

Under *each* top-level category is a maximum of twenty-five 2nd-level categories. Under *each* 2nd-level category is a maximum of 650 3rd-level categories. The table below describes the use of the four-character combination (AAAA-ZZZZ) to create these category levels.

Table 2. Creating category levels. The ? character is a "wildcard placeholder" that denotes any single character from A to Z.

Category Level (used in menu navigation)	Four-character combination (for internally indexing the categories)	Maximum number
Top Level Category	A??? through I???	9
2nd Level Category	?B?? through ?Z??	25
3rd Level Category	??AB through ??ZZ	650

Although this schema technically allows for thousands of categories---more than anyone could easily manage---the initial planning work between NPR Labs and IAAIS created a *total* of 109 categories, logically grouped among the three tiers. This is thought to be a recommended starting point for RRS Stations' categories. *See Appendix A for the list of recommended categories.*

Of course, every RRS Station can define its own set of categories to suit local needs and tastes, and these categories can be changed dynamically as RRS listener needs change (*see PAIS Command Tag Structure, below)*.

Three reserved category names will cause an immediate record, and issue an alert to the user by immediately routing audio to the headphone/speaker. These categories cannot be assigned to a program, are hard-coded into the PAIS receiver, and cannot be deleted.

- **INFO** - For informational messages from the RRS that affect its listeners. It is intended these INFO messages are treated as *special and unusual*, and appear between regular programs. INFO is **not** intended to mark routine interstitial programming or station identification. Examples are to announce changes to the program schedule, times of broadcast, and the like.

- **WARN** - Intended as Warning to imminent danger to life or damage to property.

- **EMER** - Intended as Emergency where there is an immediate danger to life or damage to property.

PAIS *COMMAND* TAG STRUCTURE

Through the course of a RRS Station's broadcast day, the station has the ability to send commands to the PAIS receiver, to cause the following actions:

Table 3. The RRS Station-issued commands to the PAIS receiver.

Add a single new category:
`<cmd name="ADD"><cat name="EDAB">Obituaries in Minnesota</cat></cmd>`
Delete a single category tag:
`<cmd name="DEL"><cat name="EDAB"></cat></cmd>`
Modify a single category tag (*same syntax as add a category)*
`<cmd name="ADD"><cat name="EDAB">Obituaries in Minnesota</cat></cmd>`

Refresh the entire Master Category list:

```
<cmd name="REF">
<cat name="AAAA>Newspapers</cat>
<cat name="ABAB">Sports, Local and Regional Newspapers</cat>
          .
          .
          .
<cat name="IBAA">Spanish, NON-ENGLISH PROGRAMMING</cat>
</cmd>
```

Erase all categories from the user's PAIS receiver:

```
     <cmd name="ERA">Erase all categories from the RRS Receiver</cmd>
```

USING THE PAIS *COMMAND* TAGS

Because first-time use PAIS Receivers may be turned on and tuned in at any time, a mechanism must exist for sending the complete master list into all PAIS Receivers on a regular basis, so the user may begin to use the PAIS features and create his/her favorites list to begin capturing programming as soon as practicable. It is suggested that an RRS Station transmit the REF (refresh) command once a day, along with the complete list of the station's categories. Built-in precautions reduce the possibility of inadvertently deleting the existing Master List, if for instance, the PAIS receiver is powered off during the load, or RRS Station reception is lost before receiving the new list. The logic flow, *left,* illustrates this protection. Please note that each RRS Station can have its own unique set of categories that will serve the local needs and tastes of its audience, and this list can be changed as RRS Station programming changes.
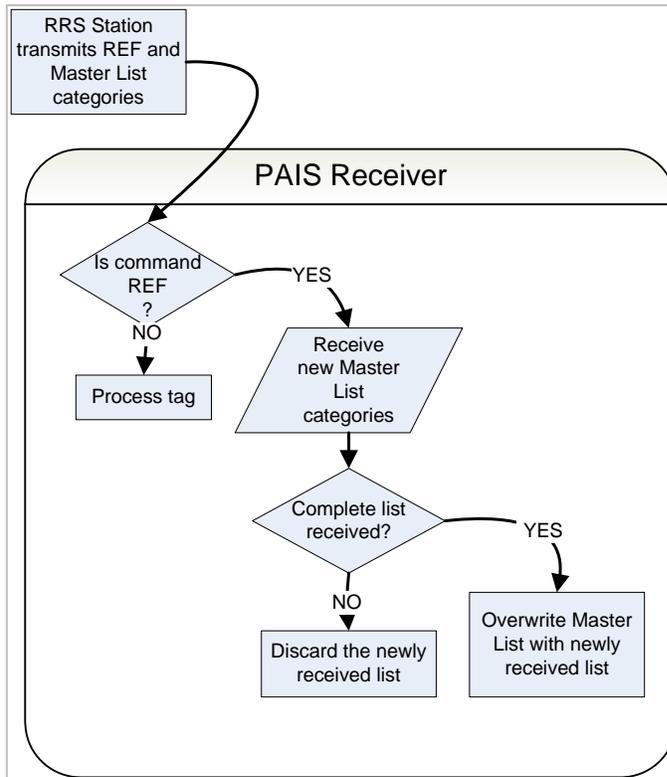
Other commands allow the RRS Station to dynamically add a single category, delete a single category, and to remotely command the erasure of the PAIS receiver's Master List (the ERA command will side-step the Master List protections that the REF command uses, and as such, is not intended for regular use until HD Radio Conditional Access makes targeting a specific PAIS receiver possible).

Transmitting the PAIS Tags Within The HD Radio Channel

The PAIS XML tags are intended to be sent within the COMment field of an HD Radio Channel. The COMment field is already implemented in iBiquity Digital Corporation's Importer/Exporter code, and does not require additional coding to transmit. HD Radio receivers already handle the COMment field, although it is not usually displayed. The illustration, *below,* shows the PAIS XML can originate from station automation and from manually pressing a button on a keypad. The PAIS PAD application translates the button press into the PAIS XML tag, and converts the XML tag (whether from keypad or automation) into the iBiquity-required PAD format and sends the result to the IBOC importer.
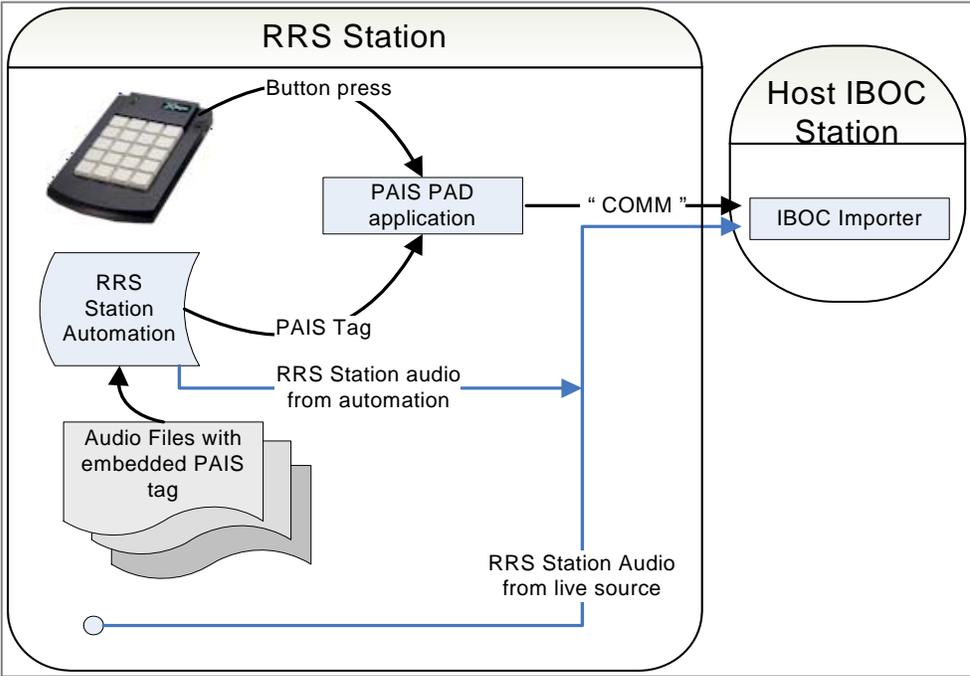
Originating the PAIS Tags During Live Programming

As shown above, PAIS tags can be generated "on-the-fly" by using a physical keypad coupled to a computer running the PAIS PAD application. In the illustration, an X-keys® Desktop keypad provides a 20 button interface, where the RRS Station has programmed each of the twenty keys to trigger the creation of a specific, i.e. "most used" PAIS tag in the PAIS application.

Each RRS Station can customize its keypad layout by pre-configuring the PAIS Application, specifying the key and the PAIS category tag that is created when a particular button is pressed.

For example, in our [hypothetical] RRS Station, the reading of the *Wall Street Journal Editorials* is about to begin. The live reader presses the button on the keypad corresponding to `Feature Sections(newspapers),Editorials` just before speaking. The PAIS XML tag is created in the PAIS Application, formatted and sent to the IBOC importer, which in turn is transmitted over the air to the PAIS receiver. The PAIS receiver responds appropriately, either starting a new recording or ignoring the tag, depending on whither the tag was found in the receiver's *MyFavorites* list.

Originating the PAIS Tags With Pre-Recorded Programming

Pre-recorded RRS programming can contain PAIS category information, and once embedded with the audio, the PAIS XML tag will be sent automatically upon each playback.

Popular file-playback automation systems typically offer a means of embedding ARTIST/TITLE/ALBUM/COMMENT "metadata" fields either within the body of the audio file, or linked to the audio file by an external database. RRS station staff manually insert the PAIS XML tag into the completed audio file (or associated database) after the file has been recorded and edited.

When these automation systems play the file, the metadata is made available in a serial data port or network data port, intended for the [broadcast] station's RDBS or HD Radio Importer/Exporter.

In PAIS, the PAIS XML tag must be sent from the automation system to the PAIS application, where it is formatted and sent to the IBOC importer, which in turn is transmitted over the air to the PAIS receiver. The PAIS receiver responds appropriately, either starting a new recording or ignoring the tag, depending on whither the tag was found in the receiver's *MyFavorites* list.

The PAIS Infrastructure Within The
HD Radio Receiver

*A description of the PAIS functionality and behavior in
the HD Radio Receiver.*

Overview

As RRS Stations transmissions migrate from an analog FM subchannel (SCA) to a digital HD Radio Channel the station will realize new services and benefits to its listeners. HD Radio transmissions natively possess data paths not only for text objects like ARTIST/TITLE/ALBUM, but for free-form text, such as the Program Associated Data (PAD) field COMMent. PAIS uses the COMMent field to transmit the PAIS XML tag to the HD Radio Receiver. The receiver, in turn, examines each received tag and acts upon the tag's content---such as begin recording the RRS Station program. The PAIS receiver then becomes a personal repository of recorded audio files of captured RRS station programming, and its user interface design and menu structure give the blind and low vision user easy ways to create a MyFavorites list of program categories, manage the captured files, browse the Master Category list, and listen to the radio.

A Personal Computer-based PAIS simulation was created in 2009, which mimicked the features of the PAIS HD Receiver along with a simulated RRS Station. NPR Labs conducted subjective testing on the PAIS User Interface with blind and low vision subjects who operated this PAIS Receiver UI by pressing keypad buttons on an external, physical human input device. The subjects were prompted by the PAIS simulator's synthesized speech software, and exercised all the menu structure described in this section. These experiments brought valuable knowledge to the project, and have continued to guide NPR Labs development of PAIS.

The PAIS HD Radio Receiver User Interface

Research at NPR Labs has refined the PAIS user interface (UI) behavior ; several rounds of subjective testing with blind and low vision users---and incorporating their helpful and reasoned comments--- has shaped the UI from its early development into an efficient, streamlined multi-level structure.

Menu navigation and feature selection is by pressing buttons on the PAIS receiver's telephone-style 12 button keypad. Research showed blind and low vision users are most familiar with this button layout; note that the telephone-style keypad arrangement is *opposite* of that found on computer keyboard keypads. The button behavior is consistent between all levels of the menu structure; that is, button "0" is always "Help"; buttons "4" and "6" are always "navigate 'left' or 'right' the menu structure; buttons "2" and "8" are always "navigate 'up' or 'down'" the menu structure, and so on.

Appendix B is a graphical illustration of the PAIS UI, *as it was prior to subjective testing*.

After every button press, the speech module in the PAIS Receiver informs the user where they "are", and when appropriate, speaks the description of the category they have "highlighted"

There are five top logical UI levels. The user is directed through voice prompts to press keypad buttons one thru five to begin interacting with the PAIS features. The five UI levels are described more fully in the following paragraphs.

THE PAIS HD RADIO RECEIVER UI-LISTENING TO RECORDED PROGRAMS
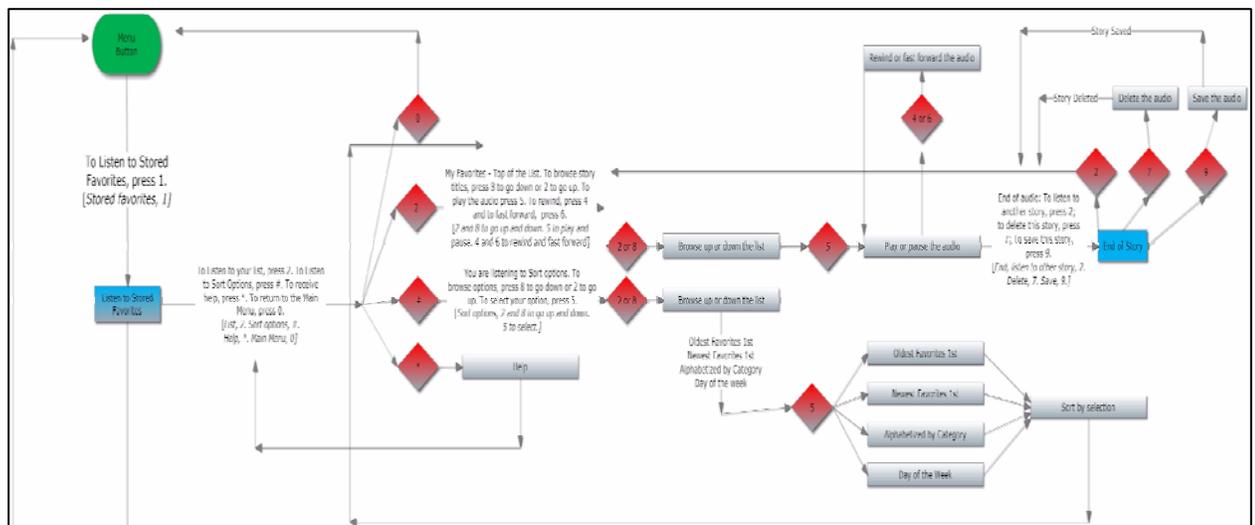
When the user presses "1", the UI speaks the functionality found at this level and prompts the user to browse the captured RRS programming. The list of audio files

can be sorted by day-of-week, oldest first, newest first, or by category (sorted alphabetically by the human friendly description----not the four character PAIS tag. Pressing "7" will delete the recording from the PAIS receiver, after the user has confirmed the deletion.
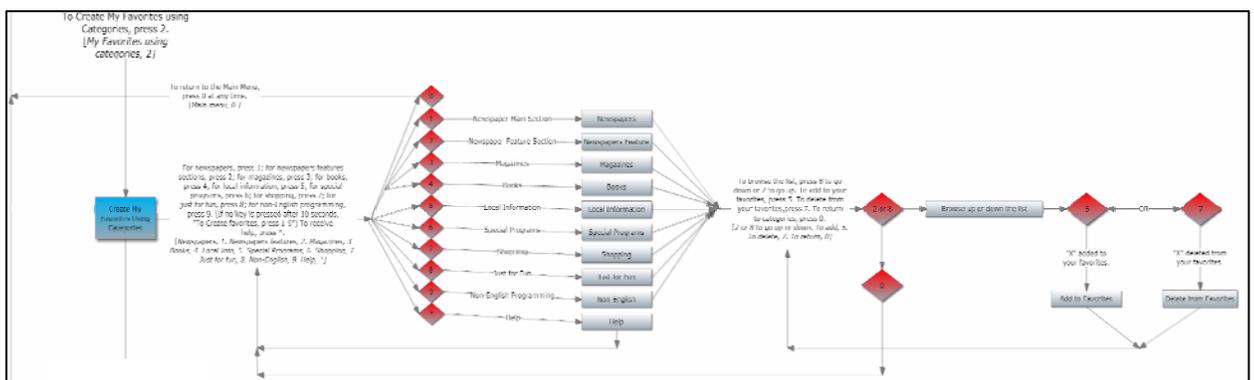
When a file has finished playing, the user is prompted to play again, browse to a different file, or delete the file.

As PAIS speaks to the user, the audio files are referred to as "stories", making the UI less about 'computers' and more about 'people'.

THE PAIS HD RADIO RECEIVER UI-'MY FAVORITES': BY CATEGORY

This top menu item gives the user the ability to create the "MyFavorites" list , as browsed by category. The user is actually browing the Master List, sent by the RRS Station every day, and creating a sub-list of "MyFavorites". A category in the MyFavorites list will be captured (recorded) in the PAIS receiver when that category (as defined by the transmitted PAIS XML tag) is broadcast by the RRS Station.

EXAMPLE:
To add the category, *Weekend, Feature Sections (newspapers)* **to MyFavorites, do this: Press 2, navigate to** *Weekend* **by pressing 8 or 2, then press 5 to add the category to MyFavorites.**

The concept of nine top-level categories is introduced in this menu structure: Each category corresponding to one of the keypad buttons 1 through 9. These nine categories were selected through the efforts of an NPR Labs/IAAIS working group, and are a recommended 'starting point' for every RRS Station. As noted earlier, every RRS Station can have a unique Master List, designed to serve the local needs and tastes of its listeners.

Once the user has selected one of the nine top-level categories, pressing the "up" and "down" keys navigate the 2nd level categories (if any), and pressing the "right"

key navigates down to a 3rd level category (if any). After each button press, the PAIS receiver speaks the human-friendly category description.

When the user presses "5", the category is added to the user's MyFavorites list, and will then be captured at the next broadcast from the RRS Station.
If the user presses "7", the PAIS Receiver prompts the user to confirm he/she wants to delete the category from the MyFavorites list.
Appendix A shows the categories, as grouped in the three-tier structure, along with the corresponding four-character PAIS tag code.

THE PAIS HD RADIO RECEIVER UI- 'MY FAVORITES': ALPHABETICAL
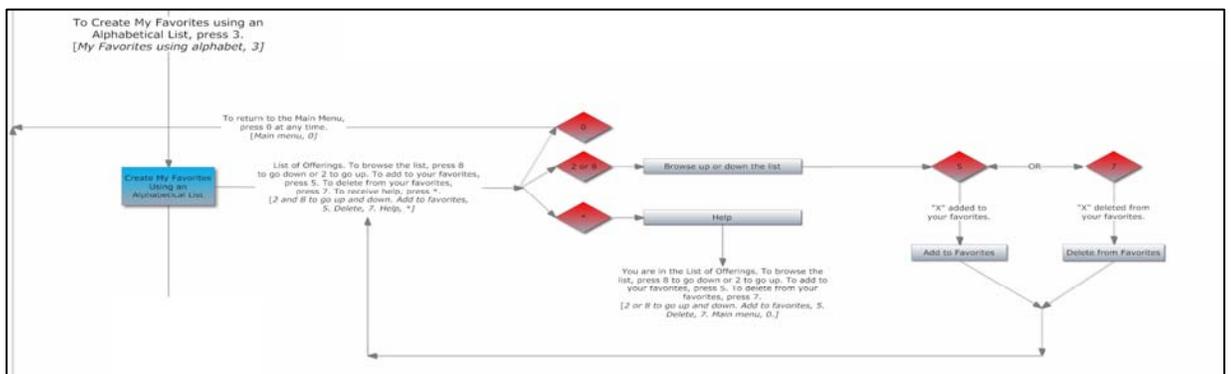
Subjective testing on the PAIS UI showed us blind and low vision users wanted to experience the Master List of categories in a 'flat-file' way. Sorting all categories alphabetically-by-description gives the users the ability to browse the *entire* Master Category list---109 categories at this time. Categories can be added and deleted from the MyFavorites list, and browsed without navigating any multi-tiered menu structure, unlike the three-level structure described earlier. Using the "up", "down" keys, the user can find the category of interest, and press "5" to add the category to his/her MyFavorites list. Pressing "7" will prompt the user to confirm he/she wants to delete the category from MyFavorites, after confirmation the category is removed.
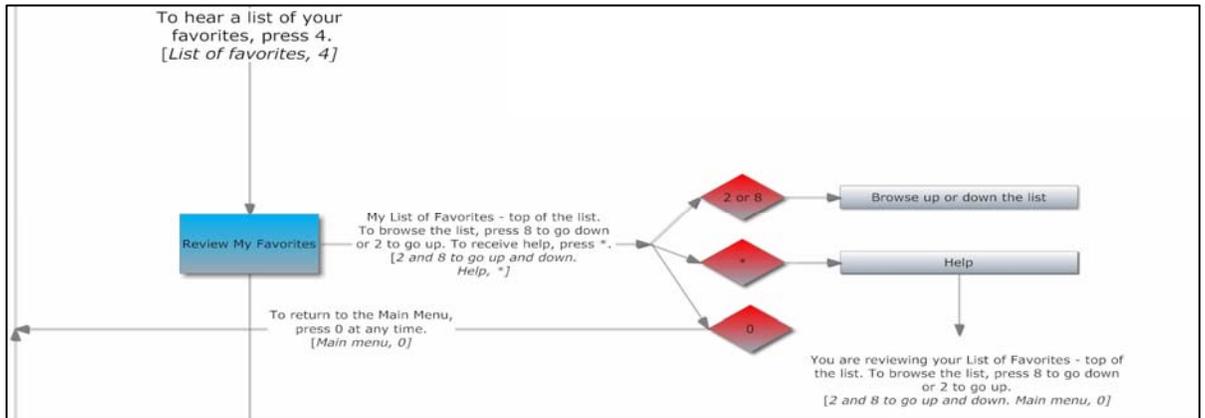
Users told us they wanted to browse their MyFavorites list, just to hear what categories they had selected, and remove categories they no longer wanted.

This menu selection only navigates the MyFavorites list; users can browse "up" and "down" the list, and press "7" to request the category be deleted from the list. Users are asked to confirm the deletion, after which the category is removed. To add a category, users must navigate to either top-level menu item "MyFavories: By Category" or MyFavorites: Alphabetical".
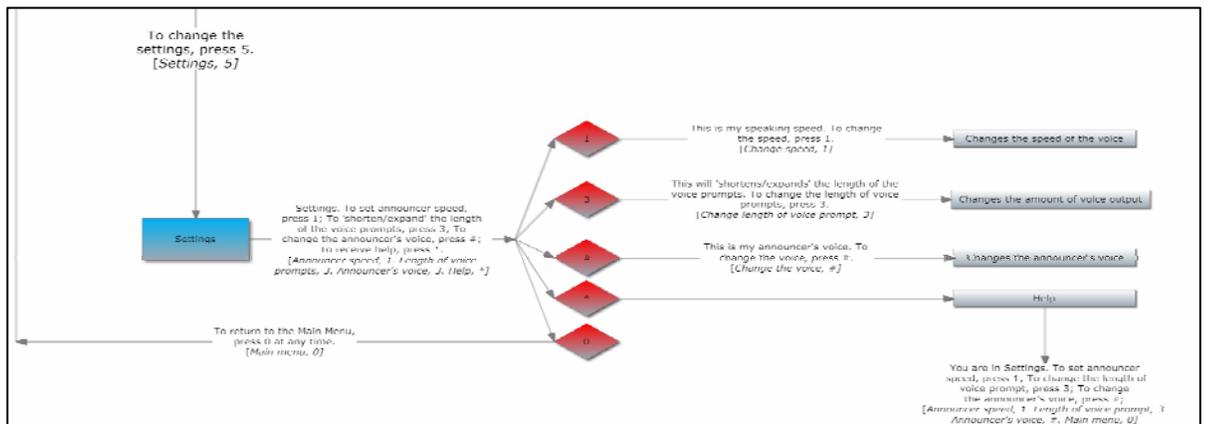
The last of the top five menu level items allows the user to configure and save various preferences, such as the following:

- Speed of spoken prompts.

- Normal or terse prompts.

- How long an audio file resides in storage before being purged.

- In the PC-based PAISSimulator software, change the speaking voice.

There may be additional user-preference selections added to this menu item

The PAIS HD Radio Receiver Internal Policies

A dialogue with manufacturers: How best to serve the blind and low vision users with the PAIS hardware?

Overview

The following internal PAIS behaviors are being studied by NPR Labs to determine how best to serve the blind and low vision PAIS user. These are global issues that affect fundamental data storage policy, operational use, emergency alerting, and other considerations, and are also fundamental to the receiver hardware itself.

NPR Labs welcomes the thoughts and suggestions of manufacturers on these topics.

Audio File Management

- What are the practical limits to the number of audio hours a PAIS receiver can store, based on internal, off-board RAM, and on-board RAM?

- How long should audio files exist in the PAIS receiver?

- Should files be purged after they exceed a user-configured "life-of-audio"?

- If the storage is near full or exceeded, should the oldest existing file(s) be deleted to make room for new files, or should the receiver only alert the user that it cannot record?

- When the user elects to "save" an audio file, how rigorous should that protection be? To the exclusion of overwriting it when the PAIS receiver storage is full?

Data Storage Management

- Should the received audio---when flagged for recording---be decoded and internally stored in another audio format, such as MP3?
  ...Or kept as a raw data stream, as implemented in the iBiquity reference receiver?

- The MyFavorites list size is <= the size of the Master List; what are practical limits to the size of the Master List, as transmitted to the PAIS receiver, in terms of reliability of reception and storage?

PAIS Policy

- When is the PAIS functionality enabled? That is, when are RRS programs captured? While the radio is tuned to the RRS Station? Can PAIS functionality be incorporated while the user is listening to a non-RRS station? i.e. separate internal HD Radio tuners?

- We assume the PAIS functionality is still operable when the receiver is in "standby"; is this a valid assumption?

- Assuming a PAIS HD Receiver is in standby when a reserved PAIS tag (WARN or EMER) is received. Should the receiver power up immediately and begin playing the message.

Further Information and Contacting NPR Labs

Please contact us at NPR Labs for answers to your questions and more detailed information about PAIS.

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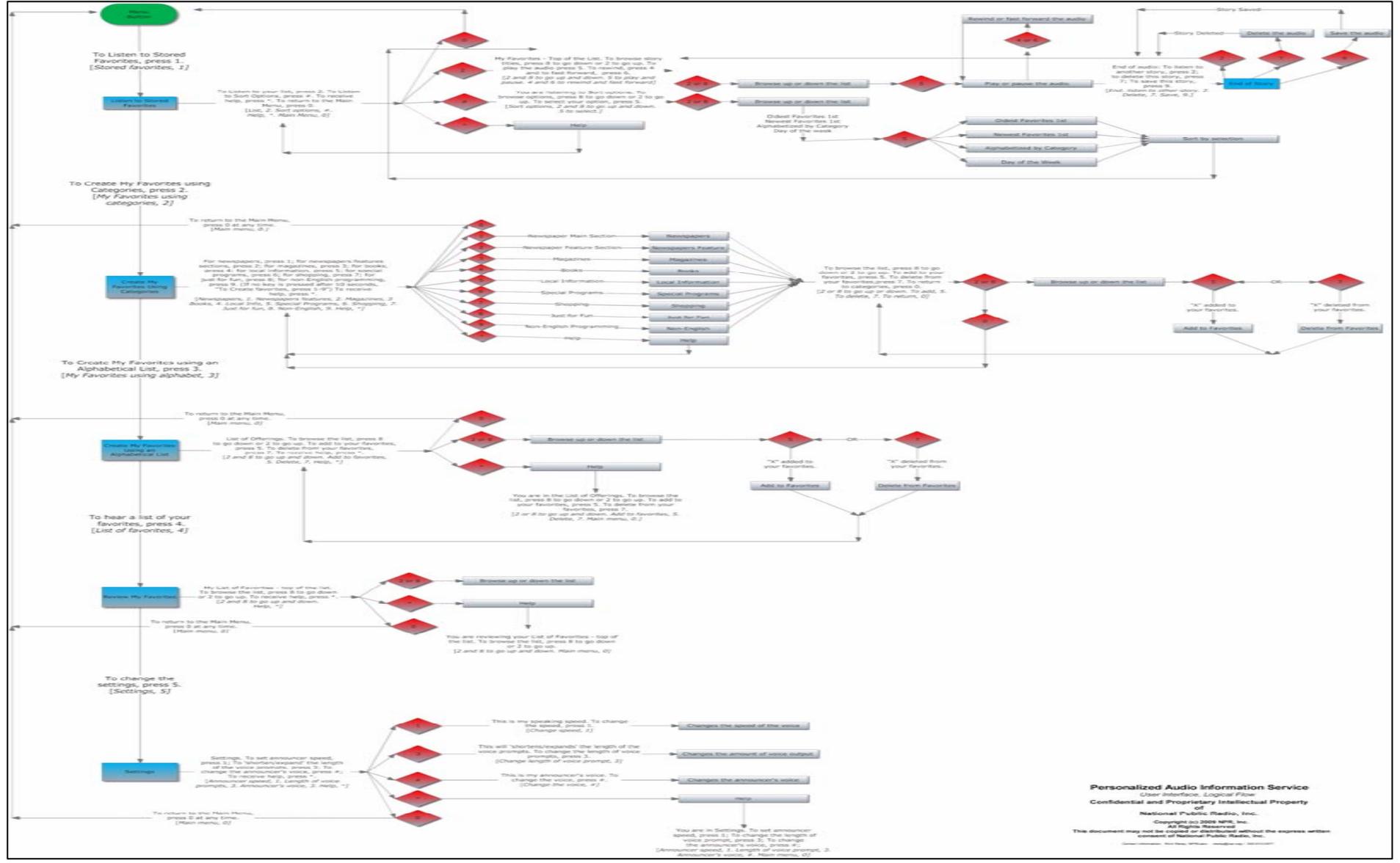mstarling@npr.org 202.513.2484

APPENDIX A – NPR LABS & IAAIS RECOMMENDED CATEGORIES BY DESCRIPTION (THREE TIER STRUCTURE)

1st Menu Level	2nd Menu Level	3rd Menu Level 1	2	3	4	5	6	7	8	9	10	11
NEWSPAPERS	Local/Regional	Sports	Business	Science	Money/Finance	Politics	Technology					
	National	Sports	Business	Science	Money/Finance	Politics	Technology					
	International	Sports	Business	Science	Money/Finance	Politics	Technology					
FEATURE SECTIONS (newpapers)	Travel											
	Weekend											
	Health/Medicine											
	Home											
	Dining/Food											
	Editorials											
	Arts/Leisure/Lifestyle											
	Disability News											
	Health											
	Religious											
	Family											
	Entertainment											
	Home and Garden											
MAGAZINE or JOURNAL	Magazine Articles											
	Sports											
	Business											
	Science											
	Money/Finance											
	Politics											
	Technology											
	Entertainment											
	Literary											
	Home & Garden											
	Kids & Teens											
	Women's											
	Men's											
BOOKS	FICTION	Book Reviews	Book Readings	Short Stories	Poetry readings							
	NON-FICTION	Book Reviews	Book Readings	Short Stories	Poetry readings							
LOCAL INFORMATION	TV Listings											
	Weather											
	Obituaries											
	Marriages											
	Births											
	Special Announcements											
SPECIAL PROGRAMS	DVS Movie											
	Old-Time Radio											
	Prime Time Radio											
	Holiday											
	Talk											
SHOPPING	Grocery	Piggly Wiggly	Giant Foods	Aldi	Safeway	Kroger						
	Retail	Drug Stores	Department Stores	Electronics	Office Supplies	Hardware	Superstores					
	Catalog	Special Aids	Department Stores	Electronics	Sports	Outdoors	Clothing/Shoes	Home/Garden	Gifts	Food	Audio Books	Braille
JUST 4 FUN	Lottery											
	Advice											
	Comics											
	Horoscope											
	Exercise											
	Game Shows											
NON-ENGLISH PROGRAMMING	Spanish*											

APPENDIX B – NPR LABS & IAAIS RECOMMENDED CATEGORIES BY CATEGORY TAG (THREE TIER STRUCTURE)

1st Menu Level	2nd Menu Level	1	2	3	4	5	6	7	8	9	10	11
NEWSPAPERS AAAA	ABAA	ABAB	ABAC	ABAD	ABAE	ABAF	ABAG					
	ACAA	ACAB	ACAC	ACAD	ACAE	ACAF	ACAG					
	ADAA	ADAB	ADAC	ADAD	ADAE	ADAF	ADAG					
FEATURE SECTIONS (newpapers) BAAA	BBAA											
	BCAA											
	BDAA											
	BEAA											
	BFAA											
	BGAA											
	BHAA											
	BIAA											
	BJAA											
	BKAA											
	BLAA											
	BMAA											
MAGAZINE or JOURNAL CAAA	CBAA											
	CCAA											
	CDAA											
	CEAA											
	CFAA											
	CGAA											
	CHAA											
	CIAA											
	CJAA											
	CKAA											
	CLAA											
	CMAA											
	CNAA											
BOOKS DAAA	DBAA	DBAB	DBAC	DBAD	DBAE							
	DCAA	DCAB	DCAC	DCAD	DCAE							
LOCAL INFORMATION EAAA	EBAA											
	ECAA											
	EDAA											
	EEAA											
	EFAA											
	EGAA											
SPECIAL PROGRAMS FAAA	FBAA											
	FCAA											
	FDAA											
	FEAA											
	FFAA											
SHOPPING GAAA	GBAA	GBAB	GBAC	GBAD	GBAE	GBAF						
	GCAA	GCAB	GCAC	GCAD	GCAE	GCAF	GCAG					
	GDAA	GDAB	GDAC	GDAD	GDAE	GDAF	GDAG	GDAH	GDAI	GDAJ	GDAK	GDAL
JUST 4 FUN HAAA	HBAA											
	HCAA											
	HDAA											
	HEAA											
	HFAA											
	HGAA											
NON-ENGLISH PROGRAMMING IAAA	IBAA											

APPENDIX D – FREQUENTLY ASKED QUESTIONS FOR MANUFACTURERS

In March 2009, NPR Labs created a Frequently Asked Questions (FAQ) sheet to inform receiver manufacturers about the PAIS project, NPR Labs role in the project, and other aspects of the project. PLEASE NOTE THE ORIGINAL FAQ HAS BEEN UPDATED FOR THIS DOCUMENT.

Frequently Asked Questions regarding NPR Labs' PAIS project

1. PAIS project background
1A. Discuss NPR Labs' progress on this project.

ANSWER: NPR Labs has performed initial concept and research into the feature set, as well as research into the Radio Reading Services' requirements for tagging the content and creating the whole transmission-to-receiver concept. NPR Labs is working with the International Association of Audio Information Services (http://iaais.org) to develop some of the concepts as they relate to existing Radio Reading Services in the U.S. We have mainly focused on the production process side of the equation with WireReady (http://wireready.com), an automation vendor the products of which are used by many Radio Reading Services.

At this time, there is no physical prototype receiver.

1B. Has the product specification been created?

ANSWER: Yes and No. NPR Labs has created the *Technical Basis of PAIS* that describes in detail the PAIS receiver's attributes, including logical operation, feature operation, menu tree, file management and other qualities of the receiver.

Some desired features, such as conditional access, and low-bitrate codec either have not been available to iBiquity, or have not been approved by the FCC, and so cannot be added to the feature list at this time.
The conditional access feature is viewed as *needed* in the final product introduction to the market, as reading services need a "safe harbor" for their verbatim readings of racy passages in best seller fiction readings and the Radio Reading Services' copyright exemption is best served with distribution only to the RRS audiences.

We would welcome the manufacturer's advice and comment.

1C. Describe how this project is being funded.

ANSWER: NPR Labs is working on the PAIS project under a multi-year grant from an office of the US Department of Education called the National Institute on Disability and Rehabilitation Research (NIDRR).
The deliverables of the grant are to produce a working *demonstration* of PAIS functionality from a transmitter to a PAIS feature-enabled receiver.
The NIDRR project narrative describes a number of evaluations made by blind and low-vision users to ensure the design is usable by the visually impaired consumers.

2. Support from iBiquity and HD Radio Stations.
2A. How many HD station broadcasters will support the category content tags? Describe the content category tags proposed for the PAIS project.

ANSWER: *The Radio Reading Services are those using the category content tags.*

BACKGROUND
There are over 100 existing over-the-air Radio Reading Services around the world providing audio service/reading services to the visually impaired populations.

In the United States, Radio Reading Services are transmitted on a FM station's subcarrier (SCA) and received by visually impaired listeners using a tuned SCA receiver. Only those people with demonstrated visual impairment are eligible to get these receivers.

The over-the-air RRS programming is this: Volunteers reading newspapers, books, magazines, advertising circulars, and other date-sensitive materials to enrich the lives of its visually impaired consumers.

The PAIS project will demonstrate how existing Radio Reading Services can migrate to HD Radio, while giving its consumers added value and benefit by incorporating PAIS features.

Currently, the programming originates from different Radio Reading Service studios and is sent by studio-to-transmitter link to a participating FM station, which in turn connects that audio into its FM SCA generator and transmits the signal along with its 'broadcast' FM and HD signals.

In Los Angeles County (USA), for example, the Los Angeles Radio Reading Service (LARRS) transmits on KCSN (88.5 FM) using KCSN's 67kHz subcarrier. The LARRS web site (http://www.larrs.org/) states that in the Los Angeles area, about 140,000 individuals have visual impairments.

In Tempe, Arizona (USA), the Sun Sounds Radio Reading Service (http://sunsounds.org/) already transmits on non-commercial FM station KJZZ's HD3 channel.

If an FM station currently participates with a Radio Reading Service, it is highly likely that that the FM station will embrace the digital upgrade for their RRS by transmitting the signals on its HD3 (or higher) channel.

The content categories, or "tags" concept is a natural enhancement to Radio Reading Services; programs are already scheduled with a category in mind, such as "front page news", "sports" and so on. The PAIS demonstration will show how every RRS can easily tag its programming, and how a consumer's HD Radio can capture and replay tagged content.

Data tags, such as "Artist" "Title" "Album" already travel transparently on HD channels; NPR Labs proposes to use the existing HD data COMMent field as the location a PAIS feature-enabled receiver would look to determine the content of a RRS program and respond accordingly.

2B. Does iBiquity have a role in this project?

ANSWER: As iBiquity Digital Corporation is the sole licensee of HD Radio Technology, they are *the* source for detailed technical information on that topic. iBiquity has provided resources to NPR Labs specifically for the development in creating PAD data, like that used in the PAIS project. NPR has signed Non-Disclosure Agreements to learn these details of HD Radio Technology that will be used for the PAIS project.

The concepts of the PAIS project demand that there be little, if any, additional burden to the participating FM station to make the Radio Reading Service as easy to implement as practicable. We are trying to design receivers and transmission schemes that get their functionality by creatively using existing HD infrastructure.

An iBiquity receiver module has AM/FM/HD receiver capability built-in. It is expected that a PAIS receiver would receive conventional AM/FM/HD programming as well as recognizing Radio Reading Service transmissions. The iBiquity HD Standard specifies a "service token" that when is TRUE, indicates the transmission is a Radio Reading Service. This service token is configured at the transmitter, and the receiver only need recognize the token.

NOTE: **To speed firmware revisions, is it practicable for NPR Labs to have a [prototype] physical receiver (that might support PAIS functionality) and the firmware sent to NPR Labs, whereby we upload it into the prototype? In this way, a prototype receiver need not be shipped across the world for evaluation---only the firmware binary.**

3. Commercial considerations for a PAIS HD Radio.
3A.What is the target unit price?

ANSWER: We expect a receiver to cost between 100USD to 200USD

3B. Who will be responsible for project development, importing, distributing, warehouse storage and payments?

ANSWER: To be negotiated.
NPR's online ordering shop has expressed an interest in promoting and selling the PAIS receiver and we would anticipate interest from IAAIS and the National Federation of the Blind organizations.

3C. Who will pay for the development costs that may include the prototype, tooling, Non-recurring engineering (NRE) costs, as well as certification and regulation compliance?

ANSWER: NPR Labs will provide a fixed development fee for the prototypes and a fixed fee for a determined number of revisions.
It is expected that we will establish the physical receiver hardware first, and revisions should be in firmware, such as moving menu items, changing the way functions interact with the user, changing the volume of the speech synthesizer, and so forth.

We have only modest sums to work with in this project, but welcome any response on what you believe to be the minimum requirements to help show a working "proof of concept" model (but not ready for manufacturing introduction).

3D.What are the projected ordering quantities? Could the PAIS HD Radio be ordered with a Minimum Ordering Quantity, such as a container load?

ANSWER: NPR Labs would propose to take an Engineering Sample order of 100 developed working prototypes---and distribute them to selected users for evaluation.

For an initial production run, we expect 2,000 units for an initial order, with subsequent larger ongoing quantities roughly in the 10,000 units per year, based on our success with the increase in the appropriation for the PTFP, which has provided matching grants for SCA receivers in the past.

3E. What would be the development and production schedule for the PAIS project?

ANSWER: NPR Labs would like to begin the prototype development as soon as practicable in 2010. We plan to demonstrate the PAIS system in its entirety at the 2010 NAB Show, using iBiquity Reference Receivers driven by our PC-based control software.
Please recall that the receiver is half of the project; the development of tagging techniques for different RRS operations must be created and the tools built for them.
We are happy to discuss schedules to the mutual benefit.

This section is an informative overview of the PAIS project for manufacturers. It was created 2009 August. The information in this appendix is superseded by other parts of this document.
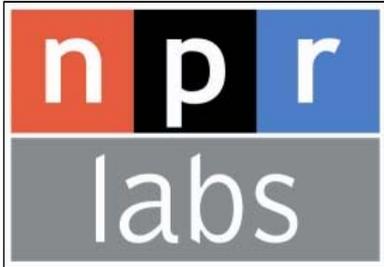
Personalized Audio Information Service (PAIS) Project
Information for manufacturers

Rich Rarey, NPR Labs
August 11, 2009

PURPOSE OF THIS DOCUMENT
This documents the requirements of NPR Labs' Personalized Audio Information Service (PAIS), a project funded by the National Institute on Disability and Rehabilitation Research, CFDA #84.133G-2.

PURPOSE OF THE PAIS PROJECT
This project will demonstrate a working HD Receiver with PAIS functionality and the transmission techniques needed to activate the PAIS-related features on the HD receiver. These designs and techniques will be suitable for integration into consumer products by others.

KEYWORDS
Radio Reading Service, RRS, Time-shift recording, PAIS, NPR Labs, Conditional Access, Category Tags

CONTENTS

DICTIONARY OF TERMS

Category
A definition of a Radio Reading Service program's subject matter.
Typical categories include "News", "Weather", "Sports", "TV Listings",
"Store Ads", "Obituaries" "Comics", "Arts & Leisure", and others.

Listener, User
Anyone who has an inability to see or hold standard printed materials is
eligible to become a radio reading service listener. Over one million
Americans aged 40 and over are currently blind and an additional 2.4
million have low vision. These numbers are expected to double over
the next 30 years as the Baby Boomer generation ages.
Source: IAAIS.org

Pre-Record Buffer
A technique of using a hardware memory buffer to delay an audio stream
A number of seconds such that when the recording is initiated, the buffer
contains that amount of audio present *before the recording was started.*
This technique reduces the chance of missing the beginning of a program.

Radio Reading Service (RRS)
A type of over-the-air transmission broadcast on a subcarrier
channel of an FM radio station. Programs are volunteers reading
books, newspapers, magazines, and other date-sensitive information.
Currently, listeners must have a special, pre-tuned radio receiver to pick
up the closed circuit broadcasts.

RRS Category Tag
A scheme created by NPR Labs to efficiently codify RRS Categories.
Currently NPR Labs proposes to place the ID and description in an ID3v2 COMMent
frame.
Such tags are in an XML format.

DESCRIPTION OF PAIS

A PAIS HD Radio receiver will have the following functionality:

1. It will recognize the Radio Reading Service (RRS) service token.
2. It will have the ability to record RRS streams to non-volatile memory, intact with associated PAD and associated data.
    a. The user can initiate a manual RRS record at any time ("save this program").
    b. The receiver's pre-record buffer holds a number of seconds of audio to allow users to replay a section of just-aired audio and give the user some assurance when manually capturing a Radio Reading Service program
    c. Only RRS streams are approved for any recording; the RRS service token is required as validation.
    d. Any automated "on the clock" recordings are to be in minimum ½ hour increments (typically the shortest segments for reading services programs).
    e. No music indexing will be within the subject matter definitions.
3. Over-the-air RRS transmissions will send Program Service Data indicating the category and description of the transmitted audio.
    a. It is anticipated that this data will conform to iBiquity's published PSD documentation.
    b. The form of PAIS category data and descriptive text within ID3v2 has been finalized, but not tested thoroughly.
    c. Initial demonstrations are targeting over 100 subject matter categories.
4. The user can select any or all desired RRS categories using menu prompts, and the user's desired categories are stored on non-volatile memory.
5. When the receiver detects a RRS category tag, it will compare that tag to the user's list. If a match, the receiver begins recording the stream.
6. Alternatively, the receiver can continuously record the audio stream and index to specific subject matter (final recommendations will depend on prototype testing for latencies in either approach).
7. It will have a voice synthesis module that will give the user audible feedback on button presses, selections and receiver responses.
8. It will recognize conditional access functionality.
9. If an approved low-bitrate audio codec is available, the transmission and receiver will use it.