NRSC REPORT

NATIONAL RADIO SYSTEMS COMMITTEE

NRSC-R208
Characteristics of Location-based Services Transmissions Using Local Radio
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NAB: 1771 N Street, N.W.
Washington, DC 20036
Tel: (202) 429-5356 www.nab.org

CEA: 1919 South Eads Street
Arlington, VA 22202
Tel: (703) 907-7660 www.ce.org

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FOREWORD

This NRSC Report is intended to inform interested parties regarding the potential for location-based services to be associated with radio broadcast program content. At this time, radio broadcaster-provided location-based services are minimally deployed with a limited number of users. Dedicated traffic and travel information services use the broadcast (and other) media to communicate traveler information to end-users, which typically employ dedicated or supplemental services that are not directly associated with the specific broadcast content. It is a goal of this NRSC Report to provide insight and suggested best practices for enabling radio broadcaster-provided location-based services.

The information contained in this NRSC Report is the work of the Location-based Services Working Group (LBSWG), a subgroup of the Digital Radio Broadcasting (DRB) Subcommittee of the NRSC. At the time of first adoption of this Report, the LBSWG was chaired by David Maxson, Isotrope, LLC, and the DRB Subcommittee was co-chaired by Glynn Walden of CBS Radio and Jackson Wang of e-Radio. The NRSC chairman at the time of adoption of NRSC-R208 was Milford Smith, Greater Media, Inc.

The NRSC is jointly sponsored by the Consumer Electronics Association and the National Association of Broadcasters. It serves as an industry-wide standards-setting body for technical aspects of terrestrial over-the-air radio broadcasting systems in the United States.

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1. SCOPE

This NRSC Report sets forth recommended characteristics of non-proprietary location-based services information transmitted on or in relation to programming broadcast US terrestrial radio broadcast stations (Broadcaster-Provided Location-based Services, or BPLBS). It is worth noting that some broadcasters are now relying upon broadband delivery methods (to consumers) to supplement over-the-air content and services, and this trend is expected to continue. Therefore, BPLBS do not necessarily need to be carried over-the-air to the end user.

2. REFERENCES

2.1. Normative references

This is an informative specification. There are no normative references.

2.2. Informative references

The following references contain information that may be useful to readers of this NRSC Report. At the time of publication the edition indicated was valid. All standards are subject to revision, and readers of this Report are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

[1] Common Alerting Protocol Version 1.2, OASIS Standard, 01 July 2010

[2] The OpenGIS® Geography Markup Language Encoding Standard (GML), Open Geospatial Consortium, Inc. OGC 07-36 V. 3.2.1

[3] OGC® KML, (KML), Open Geospatial Consortium, Inc. OGC 07-147r2 V. 2.2.0

[4] TPEG – What Is It All About?, TISA14001, January 2014

[5] ISO Standard 17572-3 Intelligent Transportation System (ITS) – Location Referencing for Geographic Databases – Part 3: Dynamic Location References, [also known as Agora-C]

[6] *NRSC-5 C Standard Reference Documents, HD Radio™ Air Interface Design Description, Station Information Service Transport (SIS)* – http://www.nrscstandards.org/SG/NRSC-5-C/1020s.pdf

[7] *Report to DRB Subcommittee – January 10, 2012 meeting*, Mr. Mike Starling, Chair, Geo-coding Usage Task Group (GUTG), National Radio Systems Committee, January 10, 2012

[8] *DRB Subcommittee Request for Proposals (RFP) - Location-based Services Protocols for Broadcast Radio Transmission*, National Radio Systems Committee, September 7, 2011

[9] HD Radio EPG Project, Phase 2 Final Report, NAB FASTROAD, March 2, 2010

2.3. Symbols and abbreviations

In this Report the following abbreviations are used:

AID	Application ID
ANSI	American National Standards Institute
BPLBS	Broadcaster-Provided Location-Based Services
BTC	Broadcaster Traffic Consortium
FIPS	Federal Information Processing Standards
LBD	Location-Based Data
LBS	Location-Based Services
LBSWG	Location-Based Services Working Group
POI	Point Of Interest
RLBS	Radio Location-Based Services
SAME	Specific Area Message Encoding
TAWG	TPEG Application Working Group
TISA	Traveler Information Services Association
TPEG	Transportation Protocol Experts Group
TTI	Traffic & Travel Information
TTN	Total Traffic Network
UE	User Equipment
USLBS	User Selected Location-Based Services

2.4. Definitions

In this Report the following definitions are used:

Broadcaster-provided location-based services	Services that are provided over radio broadcasts or by alternate means and that are related to the radio broadcast content and utilize geographic information to the benefit of the listener.
Radio location-based services	Services that are provided over radio broadcasts, not necessarily in relation to the radio broadcast content, that utilize geographic information to the benefit of the listener.
User-selected location-based services	HD Radio data system capability that allows broadcasters to virtually divide their coverage area, allowing broadcasters to provide the users in different sub-divisions with different content.

3. BACKGROUND

After study of topics in LBS with regard to radio programming, a sub-group of the NRSC's DRB Subcommittee, the Geocoding Usage Task Group (GUTG), submitted a recommendation to the DRB Subcommittee which resulted in the formation of the LBS Working Group (LBSWG) [7].

The GUTG invited proposals relating to RLBS [8]. The responses are included as Annex D to the Report. While these documents were helpful in illustrating the breadth of the field, no proposal included any specifics relating to the elements of a RLBS transmission specification. After further study, the LBSWG concluded that a review of RLBS protocols and best practices would prove useful to the broadcast technical community.

4. USE CASES

Below is a summary of potential use cases for RLBS. Because the potential uses of radio location-based services spans the range of the potential interests and activities of listeners in the radio service area, this is only a partial list of examples.

Note that while the term "POI" is indicated in the table, the description of the location of the point of interest does not necessarily take the form of a point (such as a street address or lat/long coordinates). More discussion of location geotagging methods is provided below.

4.1. Common characteristics of use cases

If there were a single overarching use-case, it might be described this way,

> *Broadcaster transmits location information as a service to the station's listeners; the location information may be directly associated with program content or with supplemental services the broadcaster provides to the listener.*

Based on this basic model, the following criteria arise, along with certain implications:

- The location-based information is related to a particular element of program content (this should be interpreted broadly, as a station may offer services that are not directly related to the current program content, for example, non-audio news flashes during music programming, emergency alerting even if not an EAS alert on audio broadcast, location of radio station's publicity van, etc.).
  - A simple means for relating program content to LBD must be established.
  - If LBD content is not instantaneously program-associated (*e.g.*, generic station LBD or independently-offered advertiser LBD), the LBD must be accompanied by other multimedia data that is sufficient to provide a context for the LBD (*e.g.*, LBD description field, map or display icon information, sponsor information).
- The location-based information may be time-limited
  - Requires the ability to delay start of use and the ability to expire.
- The location-based information may be of various structures, depending on application
  - *e.g.*, geographic coordinate point, street number and address, geographic polygon, etc.
  - An extensible but uniform set of location referencing methods should be established
- The location-based information may be of various classes
  - *e.g.*, point of interest, commercial location, event location.
  - *e.g.*, single point, polygon, or a list of points or polygons.
  - An extensible set of uniform location data classes should be established.

Table 1. Use case examples

Use Case	Category	Type	Program -related	Uses receiver location	Consumer benefit(s)	Information to transmit	Broadcaster benefit(s)	Status
1	Traffic event POI	Accidents	Possibly	Preferred	Nav system can indicate & route around incident	Location, direction, flow data (generally traffic info)	Facilitate the use and adoption of advanced broadcasters services	Already established as a business with TTN and BTC
2	Traffic event POI	Road construction obstructions	Possibly	Preferred	Nav system can indicate & route around incident	location, direction, flow data (generally traffic info); start- and end-date info	Facilitate the use and adoption of advanced broadcasters services	Already established as a business with TTN and BTC
3	Traffic event POI	Police activity detours	Possibly	Preferred	Nav system can indicate & route around incident	location, direction, flow data (generally traffic info)	Facilitate the use and adoption of advanced broadcasters services	
4	Traffic event POI	News events	Possibly	Preferred	Nav system can indicate & route around event	location, direction, flow data (generally traffic info); start- and end-date info	Facilitate the use and adoption of advanced broadcasters services	
5	Public event POI	Concerts	Possibly	Preferred	Opportunity ahead of the event. Consumer hears a song, sees a concert by the band on their nav system, smart UE or on their text-mode display, and sees a link. On the nav system, which is 3G-enabled, they have a clickable link. Either way, they can call up the band, location, date, time, ticket price range, etc.	Event details, location, building and parking information, cost, purchase info, date and time	Supplementary service improves support to current and new listeners	
6	Public event POI	Sports	Possibly	Preferred	Single location events, such as stadium sports matches, as well as events in multiple locations, such as marathons, can see the locales on screen and call up link for more information on traffic, tickets, event time, etc.	Event details, location, building and parking information, cost, purchase info, date and time; scores	Supplementary service improves support to current and new listeners	

Use Case	Category	Type	Program -related	Uses receiver location	Consumer benefit(s)	Information to transmit	Broadcaster benefit(s)	Status
7	Public event POI	Rallys	Possibly	Preferred	Directing consumers around the event or to the best event parking, transport pooling locations, based on local bus, train, shuttle activity	Event details, location, building and parking information, cost, purchase info, date and time	Supplementary service improves support to current and new listeners	
8	Public event POI	News events	Possibly	Yes	Useful for directing consumer attention to the location of a news event -police action, public appearance, judicial or other governmental or public activity not in other assigned category but newsworthy	Event details, location, building and parking information, cost, purchase info, date and time	Supplementary service improves support to current and new listeners	
9	Sponsorship POI	Station sponsorship club opportunities	Yes	Preferred	Money savings on specials via "crowdsourcing" type events similar to group coupon	Sponsorship details, location, parking information, cost, purchase info, date and time	Promote audience loyalty and facilitate local commence by strengthening advertising offerings and station relevance	
10	Sponsorship POI	Limited promotion locations	Yes	Preferred	Reinforces broadcast sponsorships as upsale or inducement	Sponsorship details, location, parking information, cost, purchase info, date and time	Promote audience loyalty and act as lubricant to local economy by strengthening advertising offerings and thereby reinforce station relevance	
11	Sponsorship POI	All dealer / distributor/ store locations	Yes	Preferred	Reinforces broadcast sponsorships as upsale or inducement	Sponsorship details, location, parking information, cost, purchase info, date and time	Promote audience loyalty and act as lubricant to local economy by strengthening advertising offerings and thereby reinforce station relevance	
12	Sponsorship POI	Live broadcast at designated sponsor site	Yes	Preferred	Provides entertainment, opportunity to meet, get to know broadcast personalities, participate in giveaways	Sponsorship details, location, parking information, cost, purchase info, date and time	Promote audience loyalty and act as lubricant to local economy by strengthening advertising offerings and maintain positive business relations	

Use Case	Category	Type	Program -related	Uses receiver location	Consumer benefit(s)	Information to transmit	Broadcaster benefit(s)	Status
13	User preference for alternate content	Geographical-ly subdivided advertising, information, etc. within station coverage area	Yes	Yes	Makes geographically-relevant advertising available to listener	Radio plays one of several audio tracks (*e.g.*, adverts) and/or data presentations (*e.g.*, location of nearest store) dependent on user location. Listener indicates preferred submarket, or GPS tells radio where in station's market the receiver is.	Promote audience loyalty and act as lubricant to local economy by strengthening advertising offerings and thereby reinforce station relevance	HD Radio system user - selected location-based services (USLBS) capability available on HD Radio transmissions. See Annex A1.
14	Social networking for listeners	Station flash mob	Yes	Yes	Allows listeners to participate in or observe spur-of-the-moment events	Radio station invites people nearby to a spur-of-the-moment event.	Supplementary service improves support to current and new listeners	
15	Public Emergency POI -	AMBER, tornado, wildfire, any immediate safety of life or property event	Possibly	Preferred	Assist law enforcement and other governmental officials in getting most needed information to consumers for immediate action and follow up.	AMBER, tornado, wildfire, any immediate safety of life or property instructions, evacuation routes, etc. CAP compliant transmission/reception of urgent information. Location, audio, image and text data possible. Radio wake-up capability (e.g. upon emergency alert).	Precise geo-targeting improves alerting relevance, maintains regular programming in unaffected locations and avoids the "cry wolf" issues for wide-area EAS alerting	Supported by HD Radio "Emergency Alerts".

Use Case	Category	Type	Program-related	Uses receiver location	Consumer benefit(s)	Information to transmit	Broadcaster benefit(s)	Status
16	Navigation system enhancement	Provide custom POIs to navigation device over radio data stream	No	No - global upgrades	Keeps consumers well informed through updated service offerings, automatically delivered via radio	Provide custom POI's to navigation device over radio data stream	Reinforces value proposition to providers and users of free over-the-air radio services by adding "NEW!" services automatically (no hardware upgrades required)	
17	Customized radio program	USLBS; receiver uses location to determine which alternative content to play/display	Yes	Required	Achieves greater relevance and supports greater use and satisfaction of radio services - Provides opportunity to "hyper-localize" content within coverage area of radio station	Location-marked content is transmitted	Improving audience targeting for sponsors and better matching programming to user needs and interests	

- The location-based information may be of various use types
  - *e.g.*, social networking (ability to share LBD), user convenience (such as traffic routing, emergency area identification, event parking...), user information (e.g. store location, augmented reality, location of a story in the news...), etc.
  - An extensible set of uniform location data attributes should be established

As was learned with the electronic program guide (EPG) study conducted for the NAB FASTROAD program [9], data services over radio can rapidly use up limited data capacity, so data utilization efficiency on the broadcast side is key. Also, by relying on a small amount of data, it is more likely the data can be repeated to improve reliability and late tune-in acquisition.

Perhaps the most efficient way to accomplish this is to transmit only enough information for a smart but not connected device (*i.e.*, not connected to the Internet) to deliver a basic level of value, and to include a token for a smart connected radio device to reach out to the cloud for richer information. This leads to receiver classes: Class A – smart, broadcast-only device; and Class B – smart, broadcast and Internet-connected (jointly) device. By "smart" what is meant is the attributes listed above relating to the hybrid radio concept would be available to the device.[1] This classification is consistent with the family of devices in Annex A, Figure A-1.

- Information intended for a Class A device could be limited to a single set of geo coordinates, street address and radius. Multiple locations for one geotagged program event could be allowed but not required, depending on data capacity available.

- Information intended for a Class B device could simply be a token that allows the device to reach out to a central server (*e.g.*, via Radio DNS or via a transmitted URL) to get the desired information, the format of which the server could decide based on the device's registered preferences (the geo equivalent of the video distinction between Flash and Quicktime). The richer the device and connection, the richer the information the server can supply.

Both classes could have header information that gives the information a title, defines what kind of information it is (for determining the applications that can use it and/or allowing the receiver to assign a suitable graphic symbol to it for visual presentation) and what program element/source/sponsor/etc. it is associated with.

Also, to accommodate visually impaired users, the information formats should not preclude applications that support non-visual interpretation of data.

[1] See Section 5.3 for more discussion of the hybrid radio concept.

5. SYSTEM ARCHITECTURE

To distinguish among the several LBS terms contained in this report, Table 2 provides a summary of the LBS domains relevant to this report.

Table 2 - Broadcast and non-broadcast LBS

Medium	LBS Service Provider	Type of Service	Type of LBS Technology	Consumer
Broadband	Internet-and-cellular-oriented services	3rd party	Internet LBS	Web browser, automotive, navigation users
	Broadcaster	BPLBS		Radio listener
Radio station transmission	Broadcaster	BPLBS	RLBS	Radio listener
	Traffic, etc. services	3rd party		Automotive, navigation users

The architecture of a potential BPLBS system is depicted in Figure 1.

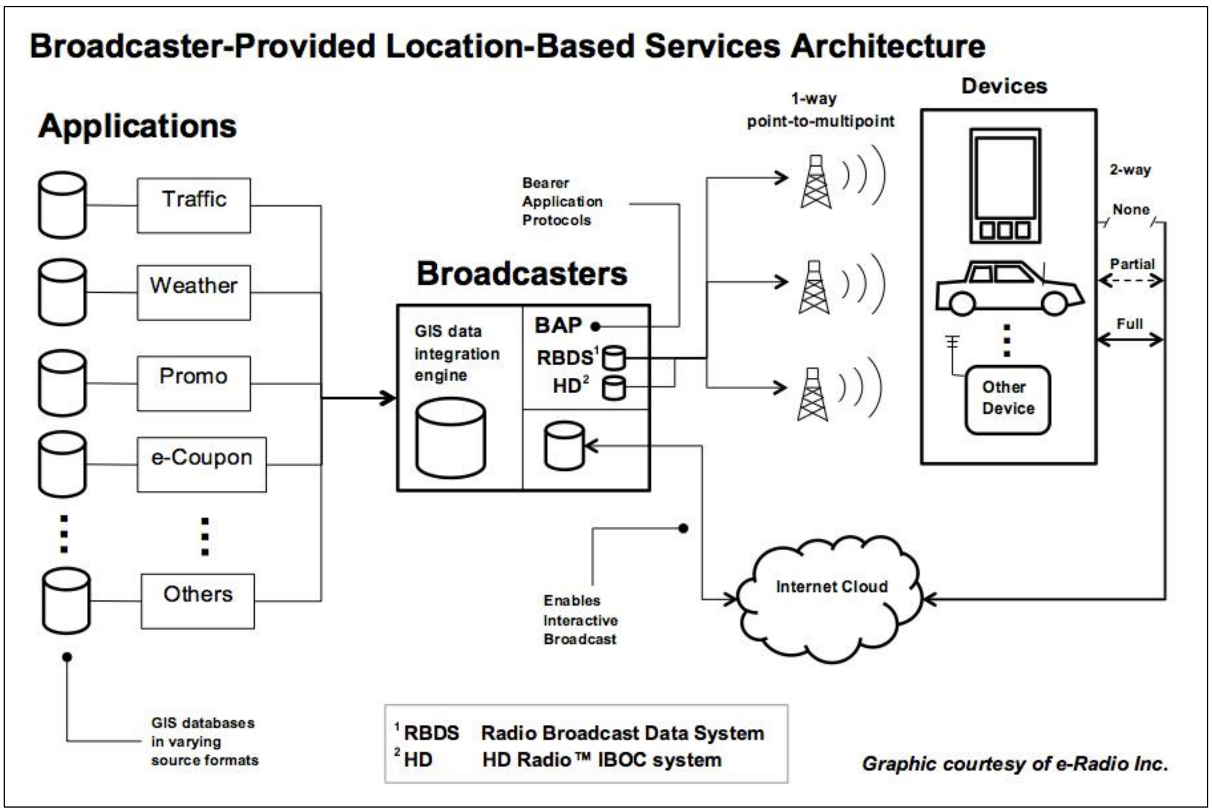

Figure 1. LBS broadcast data architecture

5.1. Applications segment

Presently there are systems that enhance the radio listener experience with song artist/title support, album art, and music tags. Similarly, an efficient, robust, flexible implementation of an LBD platform among the broadcaster's data services would allow radio broadcasters and third-party service providers to innovate new services for listeners.

Figure 1 represents only the BPLBS architecture, with the radio broadcaster at the center. This architecture is familiar to broadcast technologists, because it closely parallels the broadcast audio architecture (program content management and flow) and the broadcast supplemental services architecture (broadcast-supplemental data management and flow). For simplicity, these existing structures are not depicted in Figure 1.

The Applications segment (shown on the left of Figure 1) illustrates types of LBD which could be associated with the broadcast material. The broadcast material may be (traditional) audio, but it also might be a text stream (such as an Amber alert), a graphic image, or any other content that the station has the means and permission to broadcast.

5.2. Broadcasters segment

The Broadcasters segment (Figure 1, center) illustrates the integration of the location-based application data from the Applications segment through a station's GIS engine for distribution over various bearer channels.

In addition to the over-the-air transmission, there are bearer channels that can be conveyed over the Internet to the Devices segment. Such “back channel” data is location-specific information that is associated with broadcast material, but not sent over the broadcast channel.

5.3. Devices segment

The Devices segment (Figure 1 right) illustrates user equipment (UE) receiving the LBS material. These devices would receive the traditional (non-LBS) program material, such as audio (music, commercial spots, etc.), text, images or other broadcast content. The devices are shown receiving LBD, via broadcast and/or alternate transmission media.

Radio broadcasters are focusing on the "hybrid radio" model, in which the experience of radio broadcasting becomes more intertwined with Internet connectivity and smart devices. The implication for the Devices segment is that location-based services for radio are inherently dependent on the hybrid radio concept -- large interactive displays, receiver location identification, processing power and memory, nav apps, real-time connectivity. These device capabilities support and complement the presentation of LBD. Note also that the hybrid radio concept includes the expectation that an alternate means of communication with the UE may be available. This prospect allows for LBS data to bypass the radio broadcast and to be delivered over wireless Internet or other media, as shown in Figure 1.

6. LOCATION-BASED DATA ENVIRONMENT

The key questions regarding the requirements specification and definition of an RLBS systems architecture relate to what information would be collected and shared and how the information would be delivered to the end user (as well as carried through the ecosystem from source to final transmitter). This section considers the location references and means of transmission of those references.

6.1. Location referencing methods

Various ways of describing locations are employed in the marketplace. Most common are latitude/longitude coordinate systems (which, for display purposes on maps, require an awareness of the datum and reference ellipsoid employed by the geodetic system describing the location). Often, an underlying map or map layer may be based on different datums and/or ellipsoids. If the characteristics of each information layer are known, the mapping technology can calculate conversions to have a data point appear in the correct position with respect to the other map data.

Other forms of location referencing include street addresses and various types of zone. Zip codes, FIPS codes,[2] census blocks, and counties are examples of such zones. These location points and location areas may be stored in map databases for direct presentation, or may be referenced internally to coordinates.

Location references, as implied above, typically take the form of either a point, line segment, or a polygon.

More information on mapping solutions in the marketplace is included as Annex B.

6.2. Location reference containers

To move location reference data from source through intermediate points to the destination, it is helpful to employ a consistent location reference "container." If necessary, an intermediate delivery service may be required to translate the location reference information, unchanged in its content, to an alternative container to continue the delivery of the data to the end point. A less desirable method may require the intermediate delivery service to translate or modify or truncate the information within the container to satisfy the needs of the transport medium and/or the end user device.

6.3. Transmission and data protocols

In the following subsections, some protocols potentially suited to transmission and coding of LBS data are introduced.

6.3.1. <u>**Common Alerting Protocol**</u>

The OASIS Common Alerting Protocol specification version 1.2 [1] describes CAP in its abstract:

> *The Common Alerting Protocol (CAP) is a simple but general format for exchanging all-hazard emergency alerts and public warnings over all kinds of networks. CAP allows a consistent warning message to be disseminated simultaneously over many different warning systems, thus increasing warning effectiveness while simplifying the warning task. CAP also facilitates the detection of emerging patterns in local warnings of various kinds, such as might indicate an*

[2] Federal Information Processing Standards (FIPS) codes are superseded by ANSI INCITS 38:2009 Information Technology Codes for the Identification of the States and Equivalent Areas within the United States, Puerto Rico and the Insular Areas. For additional information see http://www.nist.gov/itl/fips.cfm.

> *undetected hazard or hostile act. And CAP provides a template for effective warning messages based on best practices identified in academic research and real-world experience.*

CAP has a location referencing capability to insure information relevant to the user's location is made available to that user. It employs location reference methods including area description, polygon, circle and geocode. The area description is a text description of the subject area, which is the minimum geographic information required in the CAP specification. Polygons and circles are referenced to geographic coordinates using World Geodetic System 1984 datum (WGS84). CAP "Geocode" refers to "any geographically-based code to describe a message target area." Examples include FIPS, SAME and ZIP codes. The CAP specification recommends using polygon and circle descriptions even when using geocode descriptions.

In addition to the Area sub-element described above, CAP also has Alert, Info and Resource sub-elements that are particular to the service of providing emergency alert information. Only the Area sub-element would be directly applicable to other RLBS purposes. To utilize the rest of the CAP framework, new categories under Alert, Info and Resource would have to be created in order to extend the CAP protocol to a broader set of use cases.

6.3.2. OpenGIS® KML Encoding Standard (OGC KML)

The KML specification is maintained by the Open Geospatial Consortium, Inc. The specification is available at http://www.opengeospatial.org/standards/kml/. OGC describes KML:

> *The OGC has developed a broad Standards Baseline. Google and the OGC believe that having KML fit within that family will encourage broader implementation and greater interoperability and sharing of earth browser content and context.*
>
> *KML is an XML language focused on geographic visualization, including annotation of maps and images. Geographic visualization includes not only the presentation of graphical data on the globe, but also the control of the user's navigation in the sense of where to go and where to look.*
>
> *From this perspective, KML is complementary to most of the key existing OGC standards including GML (Geography Markup Language), WFS (Web Feature Service) and WMS (Web Map Service). Currently, KML 2.2 utilizes certain geometry elements derived from GML 2.1.2. These elements include point, line string, linear ring, and polygon.*

The KML is oriented toward "geographic visualization", enabling a common language for describing information that is intended to be displayed on maps, browsers and the like. In incorporates elements of the GML, which is described in the next section.

6.3.3. OpenGIS® GML Encoding Standard (OGC GML)

The GML specification is maintained by the Open Geospatial Consortium, Inc. The specification is available at http://www.opengeospatial.org/standards/gml/. OGC describes GML:

> *The OpenGIS® Geography Markup Language Encoding Standard (GML) The Geography Markup Language (GML) is an XML grammar for expressing geographical features. GML serves as a modeling language for geographic systems as well as an open interchange format for geographic transactions on the Internet. As with most XML based grammars, there are two parts to the grammar – the schema that describes the document and the instance document that contains the actual data. A GML document is described using a GML Schema. This allows users and developers to describe generic geographic data sets that contain points, lines and polygons. However, the developers of GML envision communities working to define community-specific application schemas [en.wikipedia.org/wiki/GML_Application_Schemas] that are specialized extensions of GML. Using application schemas, users can refer to roads, highways, and bridges instead of points, lines and polygons. If everyone in a community agrees to use the same*

schemas they can exchange data easily and be sure that a road is still a road when they view it.

GML supports various application schemas that give a richer vocabulary than just the points, lines and polygons implemented in KML. BPLBS applications may need to rely on the simple descriptions (such as a lat/long point) implemented in KML (and in GML) for the brevity necessary to limit the data capacity required to broadcast the LBD over the air. Meanwhile, hybrid radio applications could benefit from also including more specific descriptions, such as an identifier of a street address in a street database or a specific building (or even building entrance) in a building geographic dataset. Once the user device has a cue that informs the device and the user of the presence of richer geographic information about the broadcast program, the hybrid radio device can use its Internet connection to fetch the richer LBD for presentation to the user.

If the broadcast community develops specific features and properties that are useful for providing geographic information about program content (or station related services), an extension to GML could be created to support the new features. The use of this protocol would lend a degree of interoperability with other web-based applications both on the source creation side and the end-user side of the ecosystem.

The GML Encoding Standard (v 3.2.1) [2] teaches the basics of organizing geospatial features and incorporates them in an XML schema. A “Feature” is defined by ISO 19101 as “an abstraction of real world phenomena.” A Feature is geographic in nature when it is associated with a location relative to Earth. Features are also associated with “Properties.” Properties, in this context, have a set of three characteristics: name, type and value. A Feature can have any number of properties associated with it, subject to a definition of what properties that kind of Feature is eligible to have. A Feature class might be, say, a bus stop, and Properties might include whether it is covered or not, what kind of handicap access is available, whether there is parking associated with it, what the route numbers that serve it, etc.

Features can be grouped to become effectively a single feature (a “Feature “collection”). For example, a stadium might be a Feature, comprising numerous sub-features about the stadium (entrances, for instance) and numerous properties for the main Feature and each sub-Feature.

The GML Standard recommends best practices in formulating a schema for geospatial Features. It suggests following ISO 19109 Rules For Application Schemas (features) in UML (unified modeling language) and then mapping to GML per the GML Standard, or directly applying GML XML. The key is to begin with the General Feature Model of ISO 19109.

The GML standard also recommends relying on several conceptual models for building Features:

- Conceptual schema language (units of measure, basic types) [ISO/TS 19103];
- Spatial schema (geometry and topology objects) [ISO 19107];
- Temporal schema (temporal geometry and topology objects, temporal reference systems) [ISO 19108];
- Spatial referencing by coordinates (coordinate reference systems) [ISO 19111];
- Schema for coverage geometry and functions [ISO 19123].

GML supports any datum that can be defined, however specific GML profiles can be defined to support a specific datum.

6.3.4. TPEG (Transportation Protocol Experts Group)

TPEG specifications enable transmitting multimodal traffic and travel information (TTI), regardless of client type, location or required delivery channel. Language independence has also been a prime principle in the design. The TISA Guideline [4] was written to provide a quick overview of TPEG.

In contrast to RDS-TMC (the legacy event-based road traffic information),[3] TPEG refers to a wider set of specifications, describing a range of services to users and devices involved not only in road-based traffic reporting, but also in other transportation modes (rail, marine, air, etc.).

TPEG services are defined in modules:

- Application – *e.g.*, road traffic messages, public transport information or parking information. Each Application is uniquely identified by an Application ID (*AID*) that is allocated by the TPEG Application Working Group (TAWG) of TISA;
- Transmission method – *e.g.*, DAB digital radio, DMB, Internet;
- Location referencing method – *e.g.*, table-based (using for example TMC location tables) or on-the-fly (using a method that gives a location reference that works with or without maps and does not require a look-up table to decode in the receiver);
- Device – *e.g.*, intended for vehicle navigation systems, Internet browsers or mobile devices;
- Conditional Access – whether data is sent for free or only to users/devices who have somehow established the right to receive it, *e.g.*, by paying a subscription. Encryption of TPEG data is possible by means of *Standardized Encryption Indicators* which are allocated by the TAWG.

The term "profile" is used to define a combination of the “tools” in the TPEG “toolkit” to describe a TPEG service. For example a profile might establish the tools:

- displaying traffic incidents on a map graphic and supporting re-routing or route optimization, or
- displaying public transport status information on a cell phone screen

The TPEG information contains a Content segment and Delivery segment. In the Content segment, the various sources of travel information (highway authorities, airports, airlines, train and other mass transit operators, etc.) conform to the TPEG specifications to organize traffic information and send it to control and distribution points. In the Delivery segment, the collected information is distributed to the various outlets (broadcast, highway signs, Internet portals, etc.). These outlets release the information relevant to the services they are providing. For instance, a broadcast outlet might limit the breadth and depth of information to manage the limited data capacity available and provide only what the installed base of receivers is capable of processing and presenting, while an Internet portal might provide various arrangements of the information tailored to the use case and user device (for example, mobile applications are often formatted differently than desktop applications of the same service).

TPEG is based on a set of lookup tables that enable the transmission of information in the abstract (*e.g.*, a traffic event might be coded as the value “2”). The receiving device translates that code to any number of languages (in English, the code might mean “crash”). This is particularly valuable in heavily multilingual environments such as Europe. The user device must have the memory necessary to embed the lookup tables, or network access to retrieve the translations in real time. If tables are enhanced, existing devices that do not have the ability to update themselves will just ignore new codes.
TPEG’s focus is on TTI, with plans to extend the set of supported information to weather information. TPEG is scalable to “thick” and “thin” client devices, as explained in this excerpt:

> *Navigation systems with digital maps can "machine read" the location content and localize an event directly onto the map display. A text-only client device (*e.g.*, a PDA, or Braille reader) is*

[3] RDS-TMC (Traffic Message Channel) is a service that operates on an Open Data Application of the RDS protocol. In 2007, the TMC Forum and the TPEG Forum were combined under the European Traveler Information Services Association (TISA). RDS-TMC requires a predefined table of location codes indicating specific traffic points, regions or road segments (point, area and line types). It is not suited to expansion for providing points of interest or similar features that would support some BPLBS use cases. See ftp://ftp.rds.org.uk/pub/acrobat/episode/topic12.pdf for more information on TMC.

able to present locally found names such as a railway station name and a platform number, directly to an end-user as a text message.

TPEG specifications are contained in several documents that focus on:

- Syntax, semantics and framing structure
- Service and network information
- RTM - road traffic message information
- PTI - public transport information
- LOC - location referencing applications
- PKI - parking information (pending)
- CTT - congestion and travel-time (pending)
- TEC - traffic event compact (pending)
- WEA - weather information for travelers (pending)

TPEG assigns Service ID numbers to registered services. Service ID numbers are used in the transmission of information for the benefit of the receiving device's ability to filter irrelevant information. Examples of service providers with assigned Service ID numbers include Nokia, Clear Channel, Be-Mobile, INRIX and AutoNavi.

TPEG also provides for the submission of new lookup tables. If the radio broadcast industry were to develop a set of non-traffic characteristics to associate with program content and station services, it could be reviewed for approval by TPEG as a new lookup table.

TPEG is defined in both a binary format and a markup language format. TPEG is currently under major revision to a version 2.

As with CAP, the portion of the TPEG protocols most directly applicable to RLBS would be the location referencing protocol.

TPEG location referencing (TPEG-LOC) enables rich location referencing for a variety of end-user devices and media segments. It is primarily oriented to the TTI community. A TPEG-LOC message typically consists of a) language-independent location referencing descriptions (language code as global default and specific language code for text strings that deviate from default); b) location coordinates based on location type table (*e.g.*, large area, nodal area segment and several varieties of defined point types); and c) additional description, such as hierarchical area reference to enable user device filtering of relevant LBD, and transportation network filtering (*e.g.*, auto vs subway), and node description enabling description of location of entrance or position in a transportation node, such as an airport.

6.3.5. **<u>Agora-C</u>**

The Agora-C technology provides a way to reference locations without the need to have a location database within the device. As devices have evolved to rely on lat/long coding to place routes, polygons and points on a user map, the need to pre-populate devices with application-specific geo databases has diminished. Nevertheless, it can still be challenging to identify, for example, that a restaurant, whose address is #14 Highway 66, is on the southeast corner of the intersection (due to variations in road databases and/or coordinate systems) and must be accessed from the north by turning left on Feeder Road 2 and entering the parking lot from there. Map layers often do not align perfectly, and some error tolerance is required in the process of snapping a new location data point to the user's map. Agora-C provides support for this level of complexity.

Via Licensing describes Agora-C as follows:

> *ISO Standard 17572-3, also known as AGORA-C, is a location referencing technology that is independent of underlying map technology and enables sharing highly accurate location referencing information between applications such as navigation devices, traffic information systems and other location-based services. Unlike conventional geocoding*

technologies, AGORA-C specifies a method for dynamic encoding and decoding of location references for geographic objects such as road junctions, incidents, and points of interest without requiring predefined location codes or lookup tables. Traditional geocoding-based systems may fail to locate a target accurately due to discrepancies between map data, level of detail available or differences in how objects or locations are described. AGORA-C provides highly accurate location referencing regardless of map differences. Additionally, the technology enables efficient routing based on dynamic traffic information and supports the development of proactive traffic management services that could reduce roadway congestion, promote efficient vehicle routing and help save fuel costs. Overall, AGORA-C enhances services available through traditional navigation devices and has several other potential applications for wireless location-based services.[4]

[4] Via Licensing Corporation, *Technology and Licensing Overview, ISO 17572-3 Standard for Location Referencing for Geographic Databases, Part 3: Dynamic Location References*, 2010, http://www.vialicensing.com/user-license-docs/AGORA-CTechnologyandLicensingOverview.pdf

7. SYSTEM CONSIDERATIONS

This Section presents recommendations for specific broadcast elements, transport formats and mechanisms.

7.1. Location awareness

Considered here are the location data point, its determination and the impact on system architecture. Possible ways to determine the user location include:

- GPS or other dedicated geo-positioning system
- Position inference
- User input

How the position information is determined is related to the system topology:

- Position information developed by device running application
- Position information obtained from attached dedicated device
- Position information obtained from bus or shared device

7.2. Service functionality

This Section suggests possible grouping of services based on their functionality, thus assisting broadcasters in matching a desired user experience with provided services. Items of this category include:

- Emergency Alerts via CAP message transmission
    - See http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.doc, Appendix A, for examples of CAP messages for illustration of size, format, and content.
- Emergency Alerts via HD Radio transmission
    - HD Radio Emergency Alerts (formerly Active Radio) – information details may be found in [6].
- Traffic Reports
    - Regional (omnibus reports similar to spoken traffic reports over the air, periodic and with location tags)
    - Local as applicable (location based data for each traffic event, delivered in just-in time fashion)
    - Not including Alerts, as they are covered under Alerting and subject to different origination
- Weather Reports
    - Wide area current and outlook, as regularly/periodically provided
    - Local outlook
    - Not including Alerts, as they are covered under Alerting and subject to different origination
- Localized business information
    - Advertising
    - Commerce opportunities (coupons, sells, etc.)
- Localized public information
    - Public service information (municipal, infrastructure, event, etc.)
    - Program-associated RLBS information
    - Station-associated RLBS information

7.3. Quality of Service (QoS)

This section aims to assist with providing an adequate user experience, by linking the functionality to service and/or equipment parameters that may be controlled by the broadcasters.

- QoS – priority
  - Needs to be considered when content is competing on limited delivery resources

- QoS – latency
  - Content providing resources (*e.g.*, dedicated feed, Internet, satellite link) may cause or experience delays
  - General messaging (*e.g.*, public information, certain reports) may use static resources or message queues while still satisfying expectations
  - Priority content (*e.g.*, traffic reports) may need static resources for providing adequate user experience
  - Urgent content (*e.g.*, alerting) is likely to require dynamic resource allocation and/or bypassing other services for satisfying expectations

- QoS – security
  - It is likely to be significant for alerting and reporting services
  - May not be of as much significance to public information or business information services

- QoS – authenticity
  - Should be considered for all services

7.4. Over-the-air transmission methods

The various methods available for over-the-air transmission of LBD noticeably differ from one another in content/service delivery capabilities. Broadcasters may need to consider the appropriate methods for transmission of the desired service/functionality. Receiver implementers may need to consider the appropriate transmission methods for providing the desired user experience for each receiver grade.

- RDS based transmission
  - TMC/ ODA Group 8
  - Other Group allocations (*e.g.*, EWS/ ODA 9A not implemented in USA)
  - Maximum net throughput of approximately 600 bps

- HD Radio system based
  - AAS gateway – possible multiplicity of targeted data/audio services
  - Emergency Alerts functionality (may include targeted/non targeted alert triggers)
  - Maximum net throughput of approximately 145 kbps
  - Content compression is available (typically applicable to alerting functionality)
  - Enhanced error control for specific services (typically applicable to alerting functionality)

- Digital subcarriers
  - Digital FM subcarrier technology

7.5. Implementation resources

Given here are some additional materials that the developer may consider.

7.5.1. **Presentation**

BPLBS can be presented to the listener in various forms. Fundamentally, there are display functions and there are interaction functions. Display functions include such features as an icon and/or label on a map application, or an icon or text on a static display (similar to program associated data and album art displays). Interactive functions include response and control functions such as touching an icon or menu item for more information or to respond in some other way. In a social networking implementation, the BPLBS could integrate with a social media application and provide the user with the ability to share or inquire within his social network.

Before an icon set can be established, BPLBS data feature classes and attributes must be considered. Such features as traffic events are already well supported by the various map application services and BPLBS design could cater to that existing functionality by aligning attributes with existing classes. There is the prospect of new features that are exclusively BPLBS related, which may require establishing not only attribute definitions to inform the application developer, but also possible icon designs for inclusion in an icon library.

Transmission of icon graphics over the air should be done extremely sparingly, if at all. It may be most effective to primarily rely on device and application developers to populate their icon libraries with BPLBS feature icons. The ability for a connected device to fetch an icon will provide extensibility to devices running BPLBS applications. At a minimum, an unconnected device would be best served by being able to present a generic BPLBS icon with a text label when it lacks a feature-specific icon for a new feature.

For the specific purpose of presenting alerting information, document CEA-CEB25 should be considered

7.5.2. **Symbols and icons**

The consumer user interface may benefit from the use of a set of icons to represent LBS events or points of interest. In a typical approach, the icon is signaled over-the-air with an index into a standard set of icons. ISO icons in particular have the following characteristics:

- Easy to understand – language independent
- Efficient/compact over-the-air transmission – if pre-defined in receiver memory
- Internationally unambiguous – over 160 countries participate in ISO standards
- Multi-lingual text and speech – official translation already vetted by national experts

One such standard set of icons which may be helpful to consider in developing such a system is:

- ISO 7001:2007 **Graphical symbols -- Public information symbols**
    - Public information symbols: Public facilities
    - Public information symbols: Transport facilities
    - Public information symbols: Tourism, culture and heritage
    - Public information symbols: Sporting activities
    - Public information symbols: Commercial facilities
    - Public information symbols: Behavior of the public

There is also the possibility of sending a URL reference in addition to the pre-determined index for those receivers that have Internet connectivity as per Figure 1. In those case, the receiver can retrieve additional meta-data consistent with the pre-determined short code but with more rich content.

7.5.3. **Text**

Text encoding standard ISO/IEC 8859-1:1998 is broadly established and employed in broadcast systems and in receivers. For simple and fast deployment, that may be considered as the primary text encoding method, in addition to other text encoding methods that may be used in future radio receiving devices.

While the indicated standard supports up to 27 languages, if larger sample of languages is required, then an expansion standard such as ISO-10646 may be employed. This standard already covers 8859-1 as a subset.

7.6. Broadcaster considerations

In guiding the development of BPLBS services and a BPLBS ecosystem to support these services, the following issues may be considered.

7.6.1. **Applications**

User applications are required for a listener to benefit from the transmission of BPLBS. To encourage the development and adoption of such applications, it is incumbent on broadcasters to develop a common protocol for making interoperable BPLBS possible.

7.6.2. **Ecosystem**

Elements of the ecosystem are illustrated in Figure 1. Sources of BPLBS must be cultivated, to support advertisers and underwriters – both local and national – plus content providers and broadcaster oriented services. This report considers the need for an ecosystem that generates, transports, delivers and presents BPLBS in the same fashion as other broadcast content. Resources behind the broadcaster are required for creation and transport to the broadcast facility. Applications and devices that support the presentation of BPLBS must be put in front of the listener.

7.6.3. **Protocols**

With several key map services embedded in various brands and types of consumer devices, the BPLBS protocol is best positioned in a platform-agnostic manner. Simple uniform street address text and WGS84-based coordinates are the two key components of an interoperable specification. To the extent these properties can be formatted in a manner that minimizes the memory and computational load on user devices, a BPLBS transmission protocol can be as universal and viable as possible. Coordinates can be combined to include area and polygon types of locations by the use of straightforward descriptions that would be compatible with those in common use. For broadcast over the air, a dedicated protocol may be more data capacity efficient that a full markup language. Some extensibility should be designed into such a protocol.

Administrative codes (*e.g.*, Zip or FIPS codes) are less flexible and less universal among the installed base of applications and devices than are street addressing and geographic coordinates.

7.6.4. **Attributes**

In addition to the location information, sets of attributes (*i.e.*, properties) must be developed to support the use cases that are eventually adopted.

7.6.5. **Interactions**

The simplest implementations of interactivity are, of course, in the form of presentation of BPLBS data on maps. Presentation can be triggered by a location-aware device when the user is in proximity to the point of interest or activity represented by BPLBS data.

With hybrid radio devices, such information as user location, use of BPLBS data, and user responses can be fed back to the broadcaster to create a richer BPLBS experience for the user and provide information on the utility of various BPLBS services.

7.6.6. **Graphics**

The use cases in Table 1 define what kinds of images might be associated with BPLBS locations on a map or a graphical display. At a minimum, broadcasters might establish a single symbol that indicates the information is a BPLBS feature. This will be relatively easy for applications developers to incorporate in BPLBS apps. To the extent more specialized use cases become prominent, icons for those could be developed, knowing that legacy devices may utilize generic point icons if necessary. With the limited data capacity available on the broadcast medium, and sometimes limited capacity of certain reception devices, the transmission of BPLBS icons over the air might be an inefficient use of the data capacity. Hybrid devices would be more apt to support broadcaster-provided icons.

ANNEX A: USE CASES EXAMPLES FOR USER-SELECTED LOCATION-BASED SERVICES

Figures in this Annex were provided by iBiquity Digital Corporation.

Overview

User Defined Location Based Services ("USLBS") HD Radio data system capability allows broadcasters to virtually divide their coverage area. It allows broadcasters providing the users in different sub-divisions with different content. It allows users getting content that is better suited for numerous locations per their choice, where none of them is necessarily their current location. The service does not require the receiver to be equipped with real-time position indicating capability, but may operate jointly with such capability, potentially benefitting the user.

The main points for characterizing the process include the following,

The broadcaster sends multiple advertisements, coupons/ discount info, event invitations, local news/ arbitrary local information.

a. The broadcaster sends multiple targeted content – each with its different target locations

b. Locations may be in any applicable format such as ZIP, State/County (FIPS/SAME) or coordinates.

c. The content can be in the form of audio and/or data

d. The content can be sent in conjunction with specific audible advertisement time or in conjunction with specific event

e. Delivery mechanism may be different and content dependent

    i. Data content may be delivered via data services or encapsulated in audio services

    ii. Audio content may typically use audio programs (HD3/HD4, etc.) but may also be delivered as an encapsulated data service

f. The delivery mechanism may use constant bandwidth allocation for data services or occasional large allocation at 'downtime' (such as nighttime)

    i. May take place in real time or in-advance

The receiver user may enter into the receiver his ZIP code or select from State/County list or allow linking coordinates from GPS receiver or cellular site.

g. Multiple locations may be entered

h. The user may enter his preferred locations even if he is not actually there

The received information is processed in the receiver and introduced to the user only if matching the target location, as set by the user.

Multiple target locations for single text data advertisement

Figure A-1 demonstrates the case where a station broadcasts a regular audio program (not an advertisement), while additionally broadcasting one data service that includes advertisement by local business and is targeted at specifically indicated locations. Three different receivers are shown to receive the data based advertisement.

However, receiver no. 1 user selected (and configured) locations do not match targeted location, thus no further information is available and no related indication is provided. The users of receiver no. 2 and receiver no. 3 have configured two different desired locations which both happened to match the service targeted location. As a result, these two receivers indicate 'Local info Received' and when these users press an 'info' button, they may browse the received advertisement which includes a discount code.

Multiple target location for multiple text data advertisements

Figure A-2 demonstrates another case where a station is broadcasting an audio advertisement by a store chain. In addition and directly related to the audio advertisement, the station is broadcasting three data services that include advertisements by the same chain. However, each data advertisement targets a different set of specifically indicated locations, and each location set is offered different discounts.

Three different receivers are shown to receive the audio advertisement and the data based advertisements. All the receivers play the same audio advertisement. However, receiver no. 1 user selected (and configured) locations match only a targeted location in the first data advertisement. Similarly, receiver no. 2 user selected (and configured) locations match only a targeted location in the second data advertisement, and receiver no. 3 matches only a location in the third data advertisement. As a result, all three receivers indicate to their users 'Local info Received'. However, when these users press an 'info' button, each user will see only one textual advertisement, which will be different from the one seen by the other users.

Multiple target location for multiple audio advertisements

Figure A-3 demonstrates another case where a station is broadcasting a regular audio news flash for the broad public and two news flash segments that are sponsored by local businesses/ advertisements, and are also targeted at these localities.

Three different receivers are shown to receive the audio programs and the included advertisements. Receiver no. 2 user selected (and configured) locations do not match any of the targeted location that are indicated along with the audio flash segments. Therefore, receiver no. 2 does not receive any indication regarding the local information (LI) and plays the regular audio news flash, along with the included audible advertisements. Receiver no. 1 user selected (and configured) locations match the targeted location for local audio 1. As a result, receiver no. 1 indicates the LI is provided and plays the matching local news flash along with the local audible advertisements. Similarly, receiver no. 3 user selected (and configured) locations match the targeted location for local audio 2. AS a result, receiver no. 3 indicates the availability of LI and plays the locally targeted content.

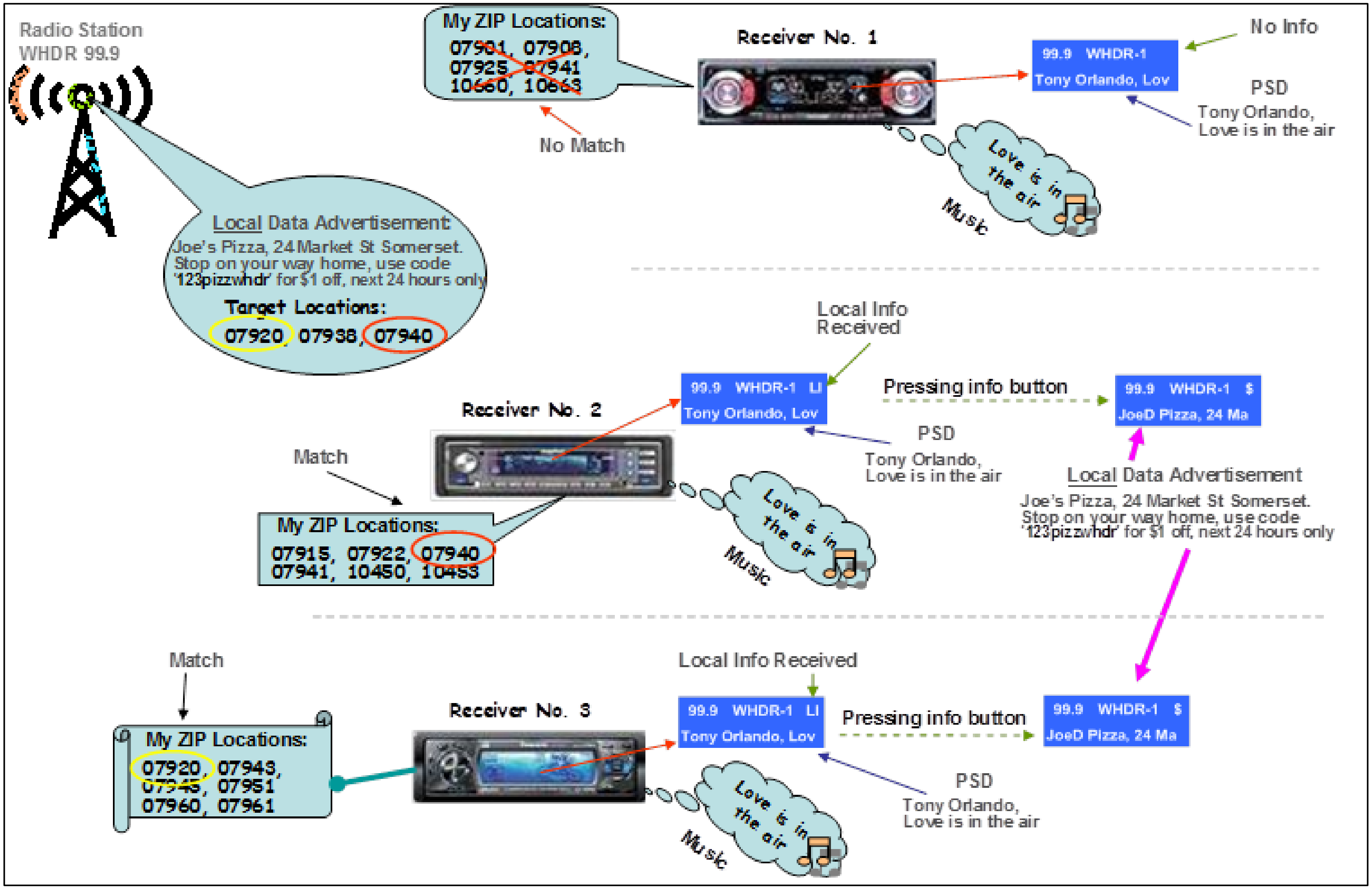

Figure A-1. USLBS example – single text advertisement with multiple target locations

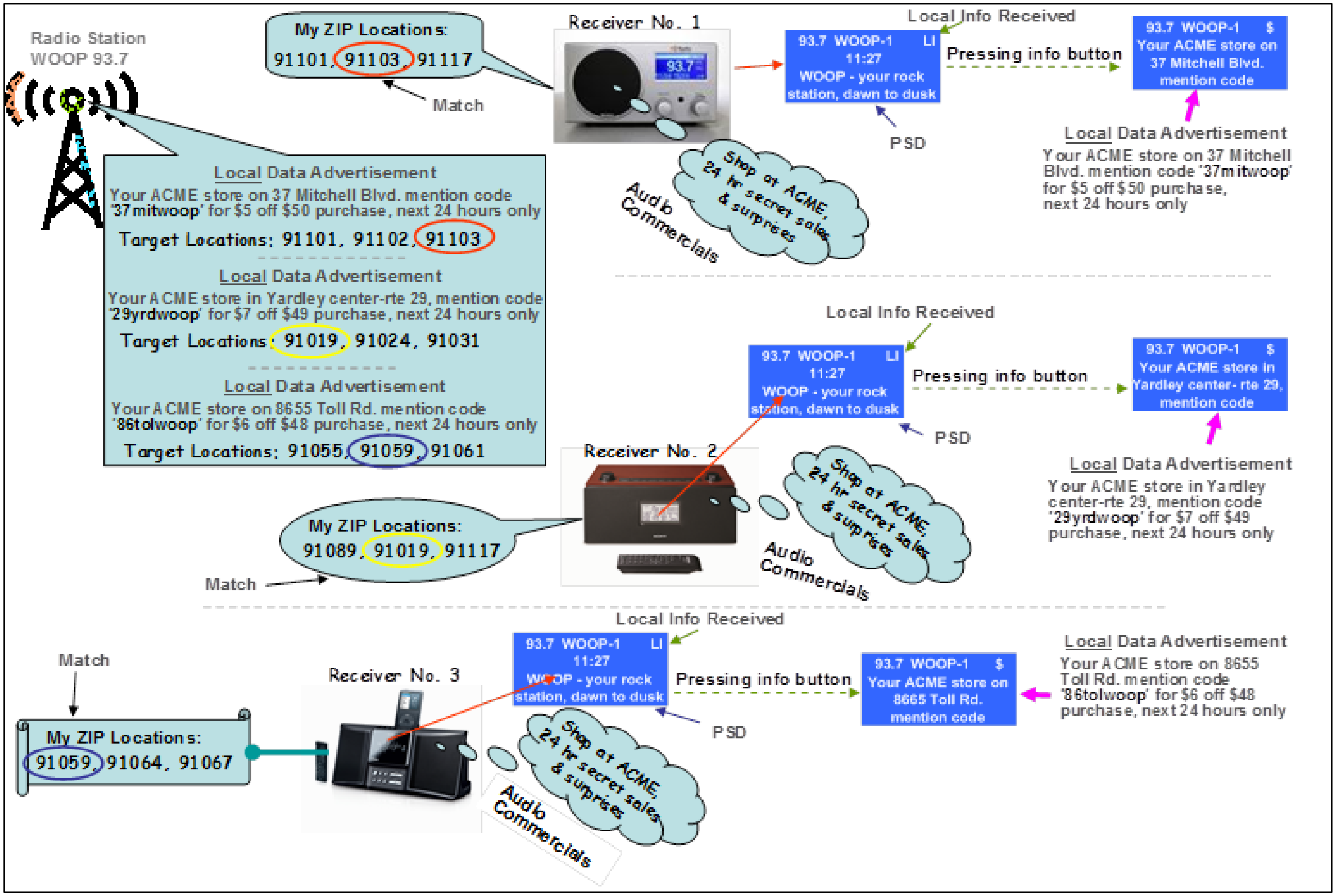

Figure A-2. USLBS example – multiple text advertisements with multiple target locations

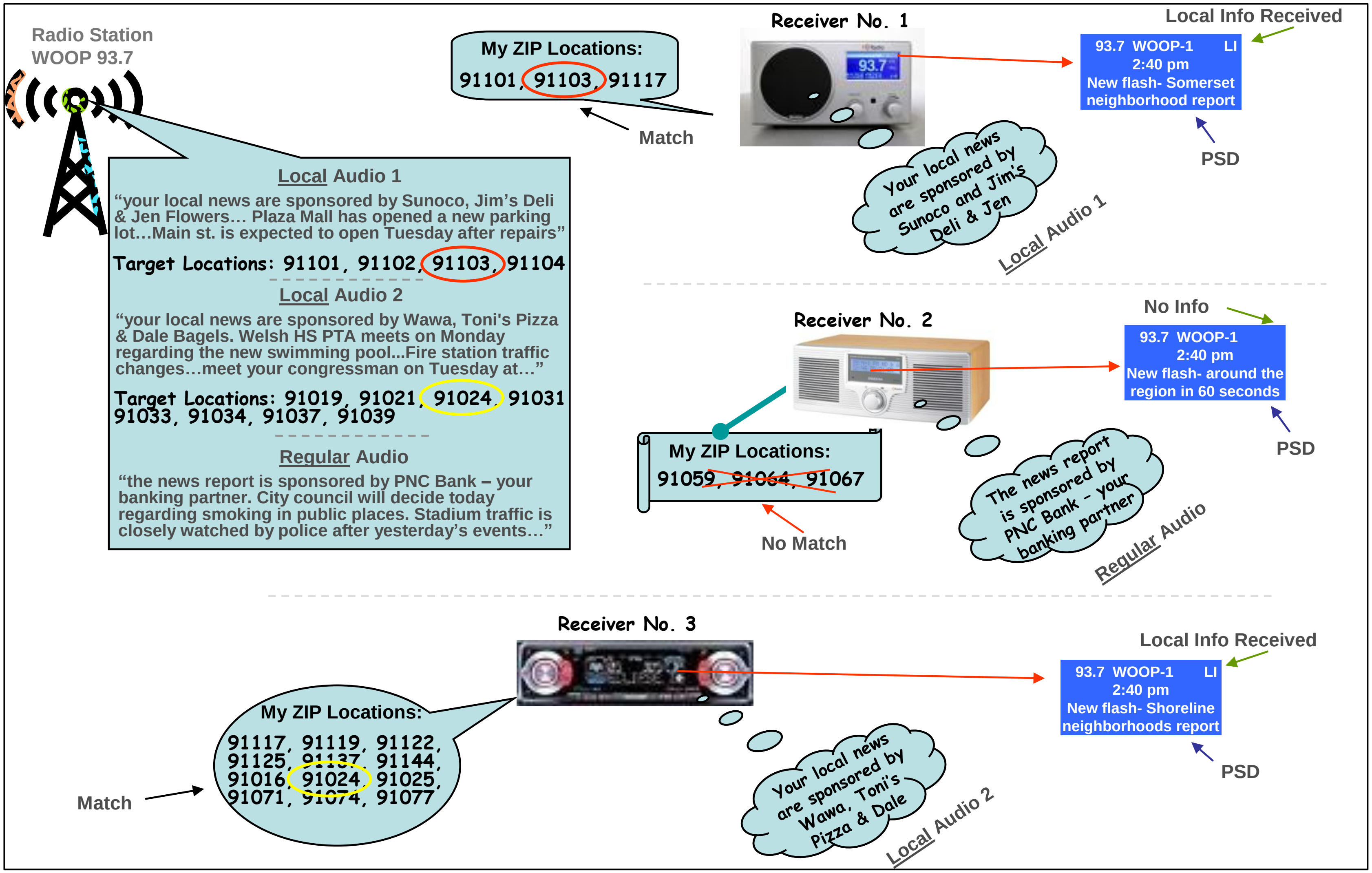

Figure A-3. USLBS example – multiple audio advertisements with multiple target locations

ANNEX B: MAP AND NAVIGATION SERVICES

There are three primary sources of national (and international) map information commonly provided on consumer devices: Nokia Navteq, Google Maps and TomTom International.

Nokia Navteq maintains an Oracle database of map information, and location and commerce features. The maps are available on all the usual media (GPS devices, browsers, dashboards, smartphone and tablet mobile apps, etc.) One of the broadcast traffic data services supports the Navteq services. Published reports indicate Navteq information is employed in 85% of in-vehicle navigation systems (2012).

Mapping services such as Navteq actively collect data in the field and update their databases. In addition to the geographic position of the roads, properties of the roads and map are maintained. These map properties are called “attributes.” Navteq cites 260 attributes including such characteristics as speed limits, number of lanes, road sign text, postal codes, administrative boundaries, and restricted driving maneuvers.

In addition to the tens of millions of miles of road and traffic information collected, there are tens of millions of “points of interest” that are maintained. These, too, have attributes, which could relate to the kinds of information that BPLBS users might seek. Navteq points of interest fall into more than 50 categories, typically in generic groupings such as “bank”, “park,” “shopping center,” “bus station”).

Navteq relies on a WGS84 datum as the reference for geographic coordinates.

Detailed public domain information on TomTom International practices is not available. In general, the TomTom system is similar to the Navteq system. Road information is updated daily. A point of interest database is maintained. A broadcast data service is supported with TomTom resources. Application developers are given APIs to create user interfaces on consumer devices.

Similarly, Google Maps are maintained with on-going field updates and include points of interest. The service is available to application developers.

In general, these mapping services enable application developers to overlay user-supplied or application-supplied information on their maps. BPLBS data could be ported into apps supporting any or all of these services as long as the information supplied by the BPLBS is of a format that the service can interpret. Commonly, each service supports the input of street addresses and geographic coordinates, among other things. Polygon overlays seem to be practicable as well.

ANNEX C: ATTRIBUTES OF SELECTED STANDARDS

STANDARD	Overview/background	Key Features/Spec (highlights)	Typical use cases	Ref docs & links
CAP	Common Alerting Protocol	XML, Lat/Long/ WGS84 referenced (*e.g.*, area, polygon, circle)	Emergency broadcast advisory	https://www.oasis-open.org/committees/download.php/6334/oasis-200402-cap-core-1.0.pdf
GML (& KML)	Open GIS(OGC GML/KML)	KML is an XML language focused on geographic visualization, including annotation of maps and images. GML is a larger schema for geospatial coding.	KML largely for Web Browser class of use. GML supports mapping in general. GML encourages specialty groups to write custom markups.	http://www.opengeospatial.org/standards/kml/
TPEG2 (ISO 21219 series)	Designed for DAB/high speed	Modular design enable wide range of LBS apps, TPEG has no need for a location database in client devices by the introduction of various location referencing methods, which can deliver very rich location information, on-the-fly, with every message, so that client devices do not need a location database.	Transportation info, Parking, Weather	http://www.tisa.org
RDS-TMC	Canned pre-coded location codes / low bitrate; European system	Pre-defined (canned) 16 bit fixed location codes efficient for low data capacity apps	TMC	http://www.rds.org.uk/2010/Overview.htm
NRSC-4-B	North American version of RDS	Limited location capability	Traffic or open data (limited)	http://www.nrscstandards.org/SG.asp
EAS	Legacy emergency alerting	Regulated as required in US, wide coverage, very limited location capability	Emergency broadcast advisory	http://www.fcc.gov/guides/emergency-alert-system-eas
NRSC-5-C	HD Radio content delivery	Any data content with several location formats	Alerting, traffic, commerce	http://www.nrscstandards.org/SG.asp

ANNEX D: RESPONSES TO NRSC RFP ON LOCATION-BASED SERVICES

RFP Response – eRadio

The eRadio response to the NRSC RFP begins on the following page.

e - Radio

Attn: Mr. David Layer
National Association of Broadcasters
Technology Department
1771 N Street, N.W. Washington, DC 20036

Subject: **Location-based Services Protocols for Broadcast Radio Transmission RFP, dated September 7, 2011**

Dear Mr. Layer,

1. In response to the above-referenced RFP, we are providing information regarding our patented e-Radio e-NAV LBS (spectrum signature location technology, location-based service) technology for consideration by the NRSC for future NRSC works in the LBS space.

2. e-Radio's e-NAV technology is specifically designed to provide a base level of LBS capability at the lowest costs as such requiring only minimal or no additional hardware depending on host device computing and RF technical specifications.

3. e-NAV is intended to be independent but complimentary to other forms of LBS, such as GPS, cell tower & WIFI hot spot triangulation. As such, we anticipate it can possibly share compatible LBS authoring GIS based tools and associated databases. It is also envisioned that e-NAV can help formulate part of the "Radio 2.0" baseline capabilities going forward. The technology is intended to accentuate the base characteristics of broadcast radio while providing meaningful value to existing high cost/performance LBS systems.

4. The initial internal validation work for e-NAV started in the late 1990s and early 2000s while undertaking mobile field testing of the data casting capability of early DAB (digital audio broadcasting) in conjunction with major North American automobile manufacturers.

5. e-Radio continued many years of innovative work and vision for LBS for the radio industry cumulating with, in 2007, issuance of a U.S. patent directed to the technology (U.S. Patent No. 7,298,328 B2, Nov. 20, 2007, entitled "Systems and Methods for Geographic Positioning Using Radio Spectrum Signatures").

6. Theory of operation and systems diagrams can be found at http://www.google.com/patents (enter US 7,298,328),

In closing, the issuing of the RFP by NRSC is a major step forward in the development of a radio based standard for Location-Based Services. We understand that the NRSC will require validation testing and evaluation of our proposal in a manner and time frame to be established by the NRSC. Should the DRB Subcommittee elect to commission next steps, we are prepared to provide assistance and access to e-Nav at reasonable terms.

Please advise should you require any additional information regarding our proposal. We look forward to working together in taking Radio to the next level.

Yours Truly,

Jackson K. Wang, P.Eng.

303 Twin Dolphin Drive, 6th floor, Redwood City, California 94065, Ph (408) 469 4376, jwang@e-radioinc.com

RFP Response – Visteon

The Visteon response to the NRSC RFP begins on the following page.

Rick Zerod
Technical Fellow- RF/Digital Radio Design
Electronics Product Group

Visteon Corporation
One Village Center Drive
Suite 30.3.011
Van Buren Township, MI
48111

Tel. 734.710.2833
rzerod@visteon.com

5 October 2011

National Association of Broadcasters
Technology Department
1771 N Street, N.W. Washington, DC 20036
Attn: Mr. David Layer

Subject: Location-based Services Protocols for Broadcast Radio Transmission RFP

Dear Mr. Layer,

In response to the above RFP, please find the attached information describing the Visteon patented "Traffic Flash" technology. This technology may be of interest to the Digital Radio Broadcasting Subcommittee as it decodes existing RBDS-TMC broadcast transmissions and uses a text-to-speech synthesizer to "announce" relevant, location-based events to the driver without requiring an in-vehicle navigation system. The inclusion of user-selectable geographic and event code data filters provide a means for presenting only pertinent information to the user.

Since a navigation display, map database, or routing software is not required, the overall system cost is reduced allowing the automotive OEM's to bring real-time, location-based information to a larger market share. With the development of additional RBDS data fields, geo-coded and time-stamped sponsorship messages could be readily implemented to enhance the system functionality and provide a potential means for revenue generation. Transport mechanisms other than RBDS-TMC (such as an HD-radio data stream) are of course possible.

This RFP response is intended to provide background information on the Visteon Traffic Flash technology as a catalyst for future discussions or consideration by the DRB Subcommittee. Since the interest level in this technology is currently unknown, it is premature to commit to any funding or providing of any hardware or test equipment as described in RFP Section 6.0. As such, no further commitments of any form are made at this time. If it is found that sufficient interest exists, then the future delivery of any required equipment can be negotiated between the interested parties.

Please let me know if there are any questions in the attached information and how we could best proceed to move forward.

With best regards,

Rick Zerod

Rick Zerod

3 October 2011

Location-Based Services Protocols for Broadcast Radio Transmission and Reception

Introduction:

The Visteon "Traffic Flash" system is a patented technology to provide customized, real-time advanced warning to the driver of adverse road, weather, and hazardous conditions without requiring the purchase of an in-vehicle navigation system. By eliminating the navigation display, map database, and routing software the system cost is minimized allowing the automotive OEMs to bring real-time, location-based information to a larger market share.

The Traffic Flash technology decodes existing RBDS-TMC broadcast information and utilizes on-board location code and event code databases to "announce" relevant events to the driver using a text-to-speech synthesizer. Dynamic re-routing is not provided and the user is expected to change their individual driving route based on the warning – same as the conventional broadcast traffic announcement model.

Through the use of GPS position information (which is currently available on the in-vehicle network in many vehicles) combined with user selectable data filters, audible announcements are only made of events that are relevant to the driver. The consumer can continue to enjoy their normal audio programming while the system monitors the RBDS-TMC messages in the background and only interrupts the current programming to provide relevant event notification.

Transport mechanisms other than RBDS-TMC are possible. Earlier development work focused on using an SDARS data transport stream, but the need for the consumer to pay a monthly subscription fee for implementing the Traffic Flash technology was a concern. An HD-Radio data stream could be another option, but this would minimally require an HD-Radio 1.5 baseband decoder in the receiver. Although bandwidth constrained, low-cost Tuner / RBDS decoder IC's are currently available making this an attractive transport mechanism from a receiver pricing perspective.

To date, the Traffic Flash technology development has focused on the customized delivery of audible RBDS-TMC messages, combined with the provisions for future-support of location based advertising and sponsorship messages. With the development of additional RDS Open Data Applications (such as additional RadioText+ class extension messages), geo-coded and time-stamped sponsorship messages could be readily implemented to enhance the system functionality and provide a potential means for advertising revenue generation.

1. High level description and theory of operation:

The following description refers to FIGURE 1 as shown below. Note this is only an example and other configurations are possible.

Traffic information is provided to the radio station from a traffic service provider. Market appropriate information is extracted and local content can be optionally added. The data is formatted as required, inserted into the RBDS (or optionally, HD Radio) data stream, and broadcast in a conventional manner.

The Traffic Flash receiver contains tuner circuitry and software that searches for and tunes to stations broadcasting the applicable RBDS-TMC data. The specific station(s) carrying the desired information can be indentified by decoding the SID and LTN data fields and comparing these values to those previously stored in the receiver memory. Other means of identifying an appropriate RBDS-TMC station may also be possible.

The vehicle contains a GPS receiver and continuously provides position information to the controller inside the radio receiver. The vehicle position information may already be available on the in-vehicle network eliminating the need for a dedicated GPS receiver for the Traffic Flash receiver. Once decoding of the RBDS-TMC data begins, the controller extracts the Group 8A Location Codes, de-encrypts the values (see section 4 below), converts these to latitude and longitude values using an internal look-up table, and calculates the distance to the vehicle location (or other positions of interest). The look-up table also contains text or phoneme information that corresponds to each Location Code value and is used by the text-to-speech synthesizer to describe the physical location to the driver.

Similarly, the corresponding Group 8A Event Code is extracted and an internal look-up table is used to determine the nature of the event. The look-up table contains an associated prioritization value for each event code (e.g., a serious accident has a higher priority value than long-term road construction) along with text or phoneme information that is used by the text-to-speech synthesizer to describe the actual event to the driver. The user has the ability to select a notification priority level which will determine which messages will (and those that will not) be actually announced.

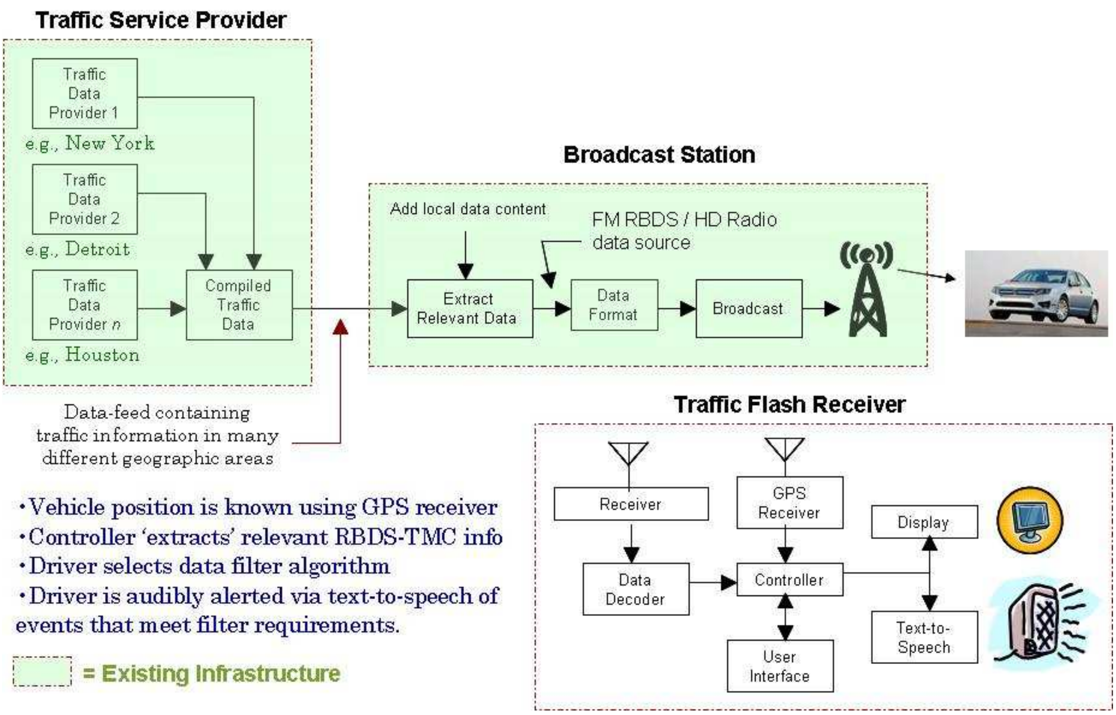

FIGURE 1

In large metropolitan areas many different RBDS-TMC messages may be broadcast during commuter time. Presentation of all of these messages to the user could result in "information overload", particularly when many of the messages are not relevant to any individual driver. To avoid this issue, the Traffic Flash receiver contains software that utilizes several data filters to determine the specific events that are actually announced by to the driver:

A. “Around Me” algorithm: This algorithm calculates the distance between each received Group 8A Location Code value to the current vehicle position. The user has the ability to select different distances from the vehicle (e.g., 5 mile radius, 20 mile radius, etc.) and notification priority levels (e.g., announce all events, announce only high priority events, etc.) Upon receiving an RBDS-TMC message that meets the data filter distance and priority level requirements, the regular audio programming is temporarily interrupted and a text-to-speech announcement describing the physical location and nature of the event is made. After the announcement is made, the receiver returns to the regular audio programming.

B. “My Routes” algorithm: This algorithm requires the user to store GPS position values associated with commonly used routes (e.g., a route from home to work, from home to the store, etc.) The Traffic Flash receiver can store several different routes and is limited only by the amount of available memory and user interface capabilities.

   To store a route, the user is required to press a “record” button and begin driving the actual route. The Traffic Flash receiver will then save a series of individual latitude and longitude waypoint values along the route. The route can be arbitrary and transverse many different streets and roads. Since the Traffic Flash receiver does not contain a map database, it does not know which roads were actually travelled and only stores a sequence of measured GPS position values. Once a driving route is finished, it can be stored and given a name by the user for subsequent recall.

   To use the “My Routes” algorithm the user begins by recalling a previously stored route. The Traffic Flash receiver will then begin to receive RBDS-TMC messages and calculate the distance between each received Group 8A Location Code value to the list of stored GPS position values associated with that route. If a Location Code is determined to be along the route, and the Event Code meets the user selected notification priority level, the regular audio programming is temporarily interrupted and a text-to-speech announcement describing the physical location and nature of the event is made. After the announcement is made, the receiver returns to the regular audio programming.

C. “Look Ahead” algorithm: This algorithm stores a sequence of GPS position values as the user is driving and dynamically determines an approximate travel direction (e.g., the vehicle is travelling northeast, etc.) The algorithm calculates the distance between each received Group 8A Location Code value to an area bounded by the anticipated direction of travel. The user has the ability to select different “look-ahead” distances (e.g., 5 miles ahead, 20 miles ahead, etc.) and notification priority values.

   Upon receiving an RBDS-TMC message that falls within the anticipated travel area and meets the notification priority level, the regular audio programming is temporarily interrupted and a text-to-speech announcement describing the physical location and nature of the event is made. After the announcement is made, the receiver returns to the regular audio programming.

Location-based sponsorship messages could proceed or supplement a text-to-speech traffic announcement. Although this has not been fully developed due to lack of appropriate over-the-air sponsorship information, one possible implementation method could be to re-define several RBDS RadioText+ class message extensions to support the additional data fields.

Some possible extension data fields could include a list of sponsors (e.g., McDonalds, Starbucks, etc.), date / time stamp information to describe the time-periods when specific sponsorship messages are to be made, and optional geographical location information (e.g., the driver could receive different sponsorship messages depending on their specific location). Additional coding of the data fields may be required for efficient RBDS transmission.

To be acceptable to automotive OEM's it is expected that sponsorship messages be minimally intrusive and linked to the announcement of a relevant event. As an example, an announcement might consist of*: "This message is brought to you by McDonalds. Eastbound I-94 at Baker Road exit 167. Traffic congestion, the average speed is about 35 miles per hour".*

2. Transmission equipment description / requirements:

Conventional RBDS transmission equipment is required. (Optionally, HD-Radio transmission equipment could be used with an appropriate means for inserting Alert-C messages into a data stream. However, this would minimally require an HD-Radio 1.5 baseband decoder in the receiver to extract the messages independent of the main program material).

Additional functionality for adding location-based advertising and sponsorship messages would require new RBDS Open Data Application extensions (such as additional RadioText+ class message extensions). Updated RBDS encoder firmware would be required to support the new extensions. Provisions for adding applicable sponsorship information to populate the new data fields would also be required.

3. Receiver equipment description / requirements:

The following description refers to FIGURE 2 as shown below. Note this is only an example and other configurations are possible.

The Traffic Flash receiver implementation is expected to use a dual-tuner approach where a low-cost, dedicated RBDS-TMC tuner / decoder is added and continuously monitors RBDS-TMC messages in the background independently from the main audio tuner. A passive splitter can be used to simultaneously provide an RF signal to each tuner from a common antenna.

In addition to the regular radio processing tasks, the receiver controller / processor and associated memory is used to perform RBDS data filtering, Location Code de-encryption, distance and priority calculations, and the speech synthesis operation. Depending on the capabilities of the processor in existing radio head unit designs, this may – or may not – need to be upgraded for increased MIPS capacity. Additional memory – including both Flash (for storage of the location code and event code look-up tables) and RAM (to support the text-to-speech synthesis) – may be required.

GPS data is currently available on the in-vehicle network in many vehicles. It is expected the radio receiver would contain a vehicle network transceiver interface and could have access to this information. (Depending on the specific OEM, the GPS information may be currently protected by a firewall from the radio receiver. In this case, access to this information would need to be negotiated with the OEM.)

Licensing of the Location Code tables and any subscription fees for access to the RBDS-TMC data would be the responsibility of the receiver manufacturer. Since it is impractical to "unsubscribe" a receiver once it is in the field, a one-time lifetime subscription fee would be the most appropriate licensing scheme. It is expected that a business model could be developed where revenues from any location-based advertising and sponsorship messages could be used to offset the subscription fees for access to the RBDS-TMC data and Location Code table licensing cost.

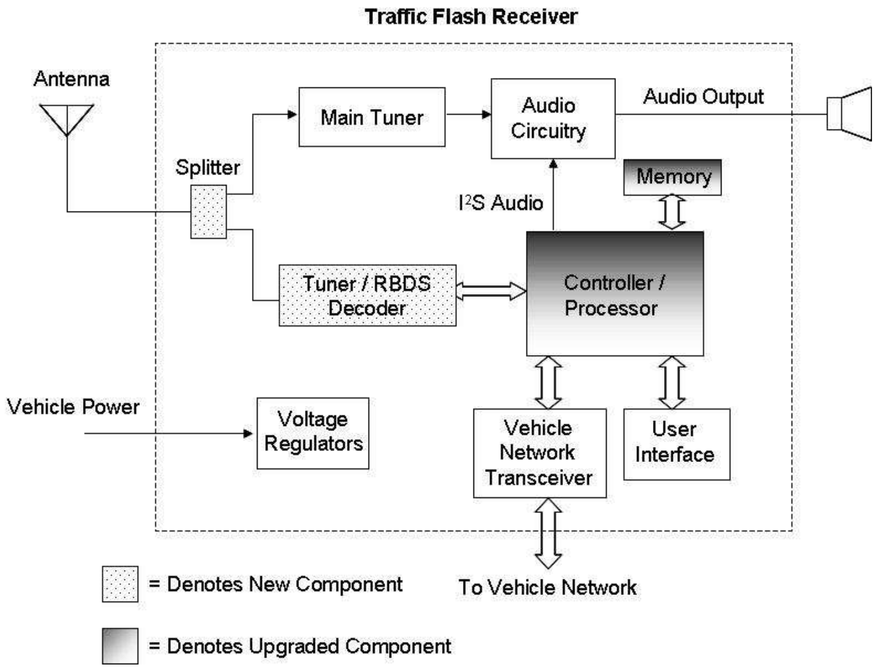

FIGURE 2

4. Description of security issues that have been considered in developing the protocol:

Since RBDS-TMC is the primary transport mechanism, compliance with NRSC-4A (or NRSC 4-B) is assumed.

Encryption of the Location Code information is provided by the broadcast service provider and is defined in ISO 14189-6. The Service Key tables that are required for de-encryption are not publicly available, but are made available to service providers and receiver manufacturers under confidentiality agreements by the TMC Forum.

An arrangement with the broadcast service provider is required in order to allow the receivers to be activated to receive the service provider's encrypted service. The broadcast service provider will inform the receiver manufacturer which Service Key they will use.

5. Compliance with (or any changes contemplated as necessary to) FCC rules:

Since RBDS-TMC is assumed to be the primary transport mechanism, no changes to the existing rules or FCC compliance issues are anticipated.

6. Other information:

This response to the RFP for Location-Based Services Protocols for Broadcast Radio Transmission and Reception is intended to provide background information on the development of the Traffic Flash technology for future development consideration. It is expected that information contained in this response will be a catalyst for additional discussions.

Since the interest level in the Traffic Flash technology by the Digital Radio Broadcasting Subcommittee is currently unknown, it is premature to commit to any future funding or the providing of any hardware or test equipment. As such, no further commitments of any form are made at this time. If it is found that sufficient interest exists, then the future delivery of any required equipment can be negotiated between the interested parties.

NRSC Document Improvement Proposal

If in the review or use of this document a potential change appears needed for safety, health or technical reasons, please fill in the appropriate information below and email, mail or fax to:

National Radio Systems Committee
c/o Consumer Electronics Association
Technology & Standards Department
1919 S. Eads St.
Arlington, VA 22202
FAX: 703-907-4190
Email: standards@ce.org

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