# Radio EPG

## RadioEPG Technical Specification

### REPG01 V1.1 (2013-10)

**The RadioDNS Project**

http://radiodns.org/

feedback@radiodns.org

**Important notice**

If you find errors in the present document, please send your comment to the document editors
feedback@radiodns.org

## Copyright Notification

# Contents

## Intellectual Property Rights

The contributors to the present document have declared that they have no IPRs in respect of their contributions.  However no investigation, including IPR searches, has been carried out, so no guarantee can be given as to the existence of other IPRs which are, or may be, or may become, essential to the present document.

## Foreword

Modern connected radio devices have the ability to use IP and broadcast technologies together to provide a compelling user experience that combines the best of both.

RadioEPG provides a methodology for devices receiving a service and other clients, to acquire additional metadata including service and schedule information.

It enables devices to be service-oriented, rather than platform-oriented, and by providing details of the different ways in which a service may be received, allows the client to choose the most appropriate. This enables a device to implement *Service Following*, where it will select between receiving the service over Internet Streaming or Broadcast as the conditions change – an implementation of a **Hybrid Radio**.

This specification has been based upon the existing DAB EPG XML specification [4].  This is in order to ease adoption for device manufacturers and service providers who may already have some familiarity with it.

## Scope

The present document defines the protocol for RadioEPG to allow implementation from both a service provider and client perspective.

## References

The following documents contain provisions, which through reference in this text constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies.

[1]     IETF RFC 2782 (2000): 'A DNS RR for specifying the location of services (DNS SRV)'

[2]     RDNS01: 'RadioDNS Technical Specification'

[3]     IETF RFC 2616 (1999): 'Hypertext Transfer Protocol – HTTP/1.1'

[4]     ETSI TS 102 818: 'Digital Audio Broadcasting (DAB); Digital Radio Mondial (DRM); XML Specification for Electronic Programme Guide (EPG)'

[5]     IEC 62106 (2009): 'Specification of the Radio Data System (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 MHz to 108,0 MHz'

[6]     ISO 3166, 'Codes for the representation of names of countries and their subdivisions – Part 1: Country codes'

[7]     NRSC-5-B:2008, 'In-band/on-channel Digital Radio Broadcasting Standard'

[8]     IETF RFC 2046 (1996): 'Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types'

[9]     IETF RFC 3986 (2005): 'Uniform Resource Indicator (URI)'

[10]    GeoRSS Specification (simple variant), http://georss.org/simple

[11]    XML Specification, use of id attribute: http://www.w3.org/TR/xml-id

[12]    IETF RFC 2806 (2000), URLs for Telephone Calls

[13]    IETF RFC 3191 (2001), Minimal GSTN address format in Internet Mail

[14]    IETF RFC 2368 (1998), The mailto URL scheme

[15]    IETF RFC 2396 (1998), Universal Resource Identifiers: Generic Syntax

## Definitions and abbreviations

For the purposes of the present document, the following terms and definitions apply:

**RadioDNS**       Centralised lookup for radio services, allowing the resolution of broadcast parameters to an authoritative FQDN as detailed in the RadioDNS specification [2].

**service**        A radio station.

**service provider**  The organisation responsible for the service(s).

**client**         A device or application for receiving and listening to a service, or an implementation of a directory service, unless explicitly differentiated.

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| AMSS | Amplitude Modulation Signalling System |
| CNAME | DNS Canonical Name record |
| DAB | Digital Audio Broadcasting |
| DNS | Domain Name System |
| DRM | Digital Radio Mondiale |
| EPG | Electronic Programme Guide |
| FCC | Federal Communications Commission (of the United States of America) |
| FQDN | Fully Qualified Domain Name |
| IP | Internet Protocol |
| NS | Name Server |
| RBDS | Radio Broadcast Data System |
| RDS | Radio Data System |
| SRV | DNS Service record |
| VHF/FM | Very High Frequency/Frequency Modulation |

# 1 Application Discovery

A device must be capable of resolving the authoritative FQDN for a service via the methodology defined in the RadioDNS specification [2].

Application lookup may then be performed against this FQDN by means of a DNS SRV Record request for the RadioEPG application by using the service name: `radioepg`

If at least one SRV record is successfully resolved, this service supports the RadioEPG application, accessed on the host and port indicated in the relevant SRV record.  For example, for a query made to:

`_radioepg._tcp.rdns.musicradio.com`

Using the `nslookup` tool, this would yield the following SRV record:

`service = 0 100 80 epg.musicradio.com.`

This indicates that the RadioEPG application can be accessed on the FQDN `epg.musicradio.com`, port `80`.

Note that more than one SRV record may be returned with different values. This can be used for loadbalancing purposes by providing different FQDNs/Ports with different priorities/weightings. See the SRV record specification [1] for a more detailed explanation on handling SRV resolution results.

## 2   Document retrieval

The host and port returned by the SRV record(s) refer to an HTTP server from which to acquire XML documents. The following sections detail these documents and how they may be retrieved and parsed.

Because the resource is returned via HTTP, the HTTP specification [3] should be correctly implemented. Attention is particularly drawn to the status codes section, which may be used to indicate problems and failures during attempts to retrieve documents.

In particular, the following behaviours must be adhered to:

A device **MUST** correctly follow any HTTP redirects that are returned when retrieving a document.

A device **MUST** respect any indicated document expiry in the HTTP response.

It is **RECOMMENDED** that devices cache retrieved documents, as per the HTTP specification.

It must also be noted that any filenames given in this document should be treated as *case sensitive* in order to support different web servers.

The HTTP specification allows for the client to send additional parameters in the request header to a service provider in order for a more appropriate resource to be returned. The following subsections give a few examples of HTTP request parameters that may be used for specific purposes. Note that other parameters may be sent by devices and clients, and a service provider may optionally choose to vary the response as a result.

If a different response is sent back from a service provider based on the request headers, it is **RECOMMENDED** that the HTTP response include the `Vary` header to indicate to any intermediate caching layers that the response has been varied because of the originating request.

### 2.1  Compression

Should a client request indicate that they accept compressed documents using the `Accept-Encoding` header, the service provider may respond with a compressed document using one of the indicated encodings.

The service provider **MUST** include the compression method of the response within the `Content-Encoding` header in the HTTP response, as per standard HTTP behaviour [3].

If requesting any compression, the client **MUST** then inspect the response to determine if, and how, any returned documents have been compressed and expand accordingly.

### 2.2  Language

Should a client request indicate desired languages using the `Accept-Encoding` header, the service provider may respond with a version of the document more appropriate to that language.

The language of the element data should be correctly indicated using the `xml:lang` attribute, where applicable (see the DAB EPG XML specification [4] for more information).

# 3   XSI document

This document is intended to detail service information for a service provider, in much the same way as provided by an SI file in the DAB EPG XML specification [4], with a restructuring of the document to make it suitable for signalling non-DAB bearers.

It holds a definition of services provided by the service provider, including any relevant metadata and bearer details, such as:

- Names (in different lengths and languages)

- Descriptions (in different lengths and languages)

- Logos (in different sizes, and formats)

- Genres

- Keywords

- Bearers the service can be received over (both broadcast and IP)

In contrast with the SI file format, the XSI document allows for the definition of **all** bearers the service is available on, over all platforms and in all locations.

This can provide enough information to allow a device to perform S*ervice Following* – i.e. enabling a switch between bearers (both broadcast and IP streaming) as suits the quality of service provided.

More details on how this may be implemented are given in Section 5, Broadcast/IP Service Following.

## 3.1   Location

The XSI document can be located in one of three ways:

- Performing a RadioDNS lookup for the RadioEPG application

- Link to URL of the XSI document within the HTML pages of the service website

- Document placed in a defined location on the service website

The first method is applicable to devices able to receive broadcast parameters or RadioDNS lookup parameter carried in-stream, and using these to form a RadioDNS query to locate the RadioEPG application and associated documents.

The second and third methods are applicable to devices, or the directory service provider supporting them, capable of locating, parsing and storing metadata from RadioEPG documents by *web crawling* across service provider websites.

### 3.1.1   Performing a RadioDNS lookup

The URL to obtain the XSI document is constructed as follows:

```
http://<host>:<port>/radiodns/epg/XSI.xml
```

Where `host` and `port` are populated by the host and port values obtained from the SRV record lookup for the RadioEPG application.

### 3.1.2 Link to URL of the XSI document within the Service website

The URL of the XSI document is contained within the (X)HTML header section `<link>` tag of any HTML pages likely to be discovered by a Directory Service Provider.

For example, for a service with a website at http://www.capitalfm.com/london, the header section may contain:

```
<head>
    <link rel="radioepg"
          href="http://epg.musicradio.com/radiodns/epg/XSI.xml">
</head>
```

For a different service with its website at http://www.classicfm.com, the header section may contain a similar XSI link.

If both services are provided by the same service provider both these links may point to the same XSI URL, and so the document may already have been retrieved and cached by a device.

### 3.1.3 Using placement in a defined location on the Service Website

The URL to obtain the XSI document is constructed as follows:

```
http://<host>:<port>/radiodns/epg/XSI.xml
```

Where `host` and `port` are populated by the host and port of the service website.

For example, for a service with a website on port 80 at `http://www.capitalfm.com/london`, the URL will be:

```
http://www.capitalfm.com/radiodns/epg/XSI.xml
```

## 3.2 Implementation

For service providers implementing the RadioEPG application:

- You **MUST** support implementation of Section 3.1.1, Performing a RadioDNS lookup
- You are **STRONGLY RECOMMENDED** to support implementation of document discovery on the standard HTTP port 80, due to the possibility that traffic on a non-standard port may be rejected by firewall/proxy configurations.
- You are **STRONGLY RECOMMENDED** to support implementation of Section 3.1.2, Link to URL of the XSI document within the Service website.
- You are **STRONGLY RECOMMENDED** to support implementation of Section 3.1.3, Using placement in a defined location on the Service Website.

For device manufacturers and developers implementing a RadioEPG client:

- You **MUST** implement at least one method for discovering XSI documents.
- It is **RECOMMENDED** to discover the XSI document immediately upon starting reception of a service.
- It is **RECOMMENDED** to cache any discovered documents as per standard HTTP behaviour.

For directory service providers implementing the ingestion of RadioEPG documents:

- You **MUST** implement at least one method for discovering XSI documents.

- It is **STRONGLY RECOMMENDED** to discover XSI documents by using Section 3.1.2, Link to URL of the XSI document within the Service website or Section 3.1.3, Using placement in a defined location on the Service Website.

## 3.3 Contents

Many elements in the XSI document are taken from the DAB EPG XML specification [4], and will be referred to as such in the text and XSD definitions (using the `epg` namespace prefix). The following sections detail the points where the specifications diverge and other important notes.

An example of an XSI is shown in Section 8.1, Example XSI Document.

### 3.3.1 serviceInformation

This is the root element of an XSI file and can contain the following elements:

- `services`
- `groups`

Its attributes are detailed below:

| Attribute | Description | Type | Status |
|---|---|---|---|
| creationTime | **Document creation datetime**<br>Initial creation datetime of this document | *epg:timePointType* | *Optional* |
| originator | **Originator**<br>Describes the originator of the schedule | *epg:originatorType* | *Optional* |
| terms | **Terms and Conditions**<br>Defines the URL of a plain text file containing Terms and Conditions of use of the Broadcaster's RadioEPG metadata.<br><br>If defined, this applies to all RadioEPG documents for all services defined within the XSI document. | *URL* | *Optional* |
| xml:lang | **Document Language**<br>Defines the default language within the document. Any elements not explicitly indicated with a different language should be assumed to use this. | *xml:lang* | *Mandatory* |

### 3.3.2 services

Can contain zero or one `serviceProvider` element and zero or more `service` elements

### 3.3.3 service

Describes metadata and available bearers for a service.

Can contain the following elements:

- `radiodns`

- `location`

- `serviceID`

- `memberOf`

It also uses the following elements from the DAB EPG XML Specification [4]:

- Service Name Group (`epg:shortName, epg:mediumName, epg:longName`)

- Media Description (`mediaDescription`)

- `genre`

- `keywords`

- `link`

At least one of each of the following elements **MUST** be specified for each service, in the default document language:

- `shortName`

- `mediumName`

- `shortDescription`

- `genre`

Additionally, each service **MUST** include an available HTTP URL of a colour logo in either JPG or PNG formats, for the following sizes (width x height in pixels):

- 32x32

- 112x32

- 128x128

- 320x240

- 600x600

It is **RECOMMENDED** that additional, larger logos also be included.

### 3.3.4 radiodns

This element details the RadioDNS lookup parameters for the service, and can be used in the discovery of additional RadioDNS applications as per the RadioDNS specification [2], Section 6.

Its attributes are detailed below:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `fqdn` | **RadioDNS Authoritative FQDN**<br>The Authoritative FQDN used in the discovery of RadioDNS applications as an alternative to using Broadcast Parameters. | *Valid domain* | *Mandatory* |

| Attribute | Description | Type | Status |
|---|---|---|---|
| serviceIdentifier | **RadioDNS Service Identifier**<br>The Service Identifier used in the discovery of RadioDNS applications as an alternative to using Broadcast Parameters.<br><br>Note that this **MUST** be unique across all the services using the same Authoritative FQDN, as per the RadioDNS specification. | *Maximum 16 lower case characters in the range [a-z][0-9]* | *Mandatory* |

## 3.3.5  serviceID

Describes an individual bearer upon which this service is carried. Its attributes are detailed below:

| Attribute | Description | Type | Status |
|---|---|---|---|
| id | **Bearer URI**<br>A descriptor of the bearer details.<br>This is platform specific and detailed in Section 7, Bearer URI Construction. | *URI* | *Mandatory* |
| cost | **Bearer Cost**<br>An indication of a relative 'cost' of acquiring the service from the service provider. This may be used by a device as a means of selecting an appropriate bearer to use.<br>This is further detailed in Section 5, Broadcast/IP Service Following. | *Non-negative non-zero integer* | *Mandatory* |
| mime | **MIME Type**<br>The MIME Type [8] of the audio carried by the bearer. | *Valid MIME type* | *Dependant on the bearer* |
| bitrate | **Audio Bitrate**<br>Bitrate of the audio carried by the bearer, in kilobits per second (kbps). | *Integer* | *Dependant on the bearer* |
| offset | **Audio Offset**<br>An indication of the offset given to the audio on this bearer by the service provider, in milliseconds relative to other bearers in the same document. | *Non-negative integer* | *Optional, defaults to zero* |

It is **STRONGLY RECOMMENDED** that a service lists all of its available bearers, in order to assist Service Following, as discussed further in Section 5, Broadcast/IP Service Following.

Each bearer may have additional requirements, as listed below:

### 3.3.5.1  VHF/FM

Each VHF/FM bearer is **RECOMMENDED** to be given in **BOTH** forms, as specified in Section 7.1, VHF/FM. That is, one bearer URI constructed using the GCC, and another bearer URI constructed using the country code.

For example, a single FM bearer may be expressed using the following two URIs:

```
fm:gb.c479.09580
fm:ce1.c479.09580
```

### 3.3.5.2  DAB/DAB+ Digital Radio

The `mime` attribute is **MANDATORY** for this bearer, and must be defined as `audio/mpeg` for DAB and `audio/aacp` for DAB+ services.

### 3.3.5.3  Digital Radio Mondiale (DRM)/AM Signalling System (AMSS)

The `mime` attribute is **MANDATORY** for DRM, and should be defined as the MIME type of the encoded audio stream.

### 3.3.5.4  iBiquity Digital Corporation's HD Radio™ (HD Radio™)

No additional requirements.

### 3.3.5.5  HTTP-based

The `mime` attribute is **MANDATORY** and indicates the MIME type of the audio codec carried in the HTTP response.

The `bitrate` attribute is **RECOMMENDED** and should indicate the bitrate of the audio stream.

### 3.3.6  memberOf

This can be used to group services together for the purposes of similar service selection or presentation to a user. A service may be a member of zero or more groups, using zero or more `memberOf` elements.

The group the service belongs to is indicated with the `id` attribute in the following manner:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `id` | **Group Identifier**<br>An identifying string for the group. | *string* | *mandatory* |

Other members of the group should share this identifier to be placed in the same group, and the group should be defined with the exact identifying string as stated within the group definition within the relevant `group` element (see Section 3.3.8, group).

### 3.3.7  groups

Contains zero or more `group` elements. Zero or one of this element may exist under the `serviceInformation` element.

### 3.3.8  group

This can be used to hold the details of a group, which can be used to group services together for the purposes of similar service selection or presentation to a user. The group identifier is contained within the `id` attribute in the following manner:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `id` | **Group Identifier**<br>An identifying string for the group. | *string* | *mandatory* |

It can also contain the following descriptive elements from the DAB EPG XML Specification [4]:

- Service Name Group (`epg:shortName, epg:mediumName, epg:longName`)
- Media Description (`mediaDescription`)
- `genre`
- `keywords`
- `link`

These are all specific to the group they are specified within.

A service determined to be a member of the group should use this group identifier in its `memberOf` element (see Section 3.3.6, memberOf).

### 3.3.9 serviceProvider

Contains information on the provider of the services detailed within the XSI document. Zero or one of this element may exist under the `services` element.

Can contain the following elements:

- `location`

It may also contain the following descriptive elements from the DAB EPG XML Specification [4]:

- Service Name Group (`epg:shortName, epg:mediumName, epg:longName`)
- Media Description (`mediaDescription`)
- `link`
- `keywords`

### 3.3.10 location

This may be used to indicate geographical applicability, using zero or more of the following child elements in any combination.

| Element | Description |
|---|---|
| `country` | **Country Code**<br>Specifies location by country, using ISO 3166-1 alpha-2 country codes [6]. |
| `point` | **Point**<br>Based on the `georss:point` type [10], this specifies a point by latitude and longitude, in the format:<br><br>`<latitude> <longitude>` |
| `polygon` | **Polygon**<br>Based on the `georss:polygon` [10] type, this specifies a space-separated series |

| | of points by latitude and longitude, forming a enclosed area, in the format: `<[<latitude> <longitude>]...>` |
|---|---|

Each may be interpreted in a different way based on its parent element and no particular meaning is mandated. The following paragraphs are given as suggestions:

A *country code* for a `serviceProvider`, `service`, `group` or `serviceID` may indicate the country or countries in which it is available, accessible, or located.

A *point* for a `serviceProvider` or `service` may indicate the exact coordinates of where it is based, i.e. the location of the Service Provider or Station. For a `group` this may be set of points indicating the locations of the services within the network the group represents, or a single point showing the network centre. For a `serviceID`, it may represent the coordinates of the transmitter it represent, for broadcast bearers.

A *polygon* for a `service` or `group` may indicate the editorial or 'brand' area for that `service` or `group`. For a `serviceID` it may indicate the effective transmission area for broadcast bearers – to be used by as additional information for clients wishing to perform service following between the different bearers of a service.

### 3.3.10.1    Examples

Against a `serviceProvider` element, showing the location of the provider of the service.

```
<location>
  <country>GB</country>
  <point>51.473939 -2.508112</point>
</location>
```

Against a `service` element, showing its 'brand' area as a polygon:

```
<location>
  <polygon>
    51.524124 -2.709503 51.572803 -2.668304 51.616310 -2.572174
    51.575363 -2.412872 51.504471 -2.379913 51.426613 -2.471924
    51.400063 -2.460937 51.387211 -2.511749 51.328896 -2.708130
    51.273087 -2.772675 51.238705 -2.938843 51.258476 -3.036346
    51.376068 -3.026733 51.472401 -2.859879 51.524124 -2.709503
  </polygon>
</location>
```

### 3.3.10.2    Cross Referencing

The `location`, `country`, `point` and `polygon` elements may have the optional attribute `xml:id`, which has special meaning within the XML specification [11] as a way of uniquely indexing and cross-referencing elements.

If an element has been given this attribute, other instances of the same element at any point in the document may inherit its definition by using the `ref` attribute, with the value exactly matching the value defined in its `xml:id` attribute.

The following restrictions apply:

- An element containing a cross-reference to another **MUST NOT** define any child elements or content.
- If an element makes a non-existent reference, then the entire element **MUST** be ignored.
- An element **MUST** only make a cross-reference to another element of the same type within the same document.

This may be used to define a point, country/countries, polygon or an entire location only once within a document, and make cross-references where applicable. For example, when indicating multiple FM broadcast bearers with the same transmission area:

```
<serviceID cost="30" id="fm:ce1.c36b.09630">
  <location xml:id="bristol-fm">
    <polygon>
      51.574081 -2.660065 51.551460 -2.545395 51.555302 -2.408752
      51.533096 -2.376480 51.480099 -2.400513 51.394920 -2.489090
      51.393208 -2.592087 51.417194 -2.664185 51.489937 -2.736969
      51.574081 -2.660065
    </polygon>
  </location>
</serviceID>

<serviceID cost="30" id="fm:gb.c36b.09630">
  <location ref="bristol-fm"/>
</serviceID>
```

Both describe the same FM bearer with both forms of the GCC, with an equal transmission area. To avoid duplication, the first occurrence of the location element is marked with an identifier using the `xml:id` attribute, and subsequent occurrences should cross-reference to this by using the `ref` attribute.

## 3.4  Service Filtering

A device implementing direct ingestion of XSI files from a service provider, rather than through a proprietary directory service provider interface, may wish to reduce the amount of data returned in the response. This may be a consequence of hardware resource limitations, e.g. processing power or available memory, or a desire to minimise bandwidth consumption.

A device or other client, requesting an XSI, may optionally provide information to the service provider to indicate particular bearers in which they are interested in receiving further service information.

The service provider may optionally respond with a response containing a subset of their complete service list, more applicable to the bearers specified in the request. This may be only the service(s) using these bearers, but the client must not make this assumption and should still parse and perform any bearer matching to identify particular services (see Section 5.4, Bearer Matching).

### 3.4.1  Client Request

The client request takes any of the forms given in Section 3.1, Location, with a querystring appended in the following format:

```
<url>[?[bearer=<bearer>][[&bearer=<bearer>]...]]
```

Where `url` is the original base URL. The querystring is populated as follows:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `bearer` | **Bearer URI**<br>Bearers the client wishes to request from the service provider, expressed in the format as specified in Section 7, Bearer URI Construction.<br><br>This parameter may be repeated in the querystring to request multiple bearers. | *URI* | *optional* |

All query parameter values must be properly encoded to contain only URI-compliant characters [9]. For example, a request for the following bearer URIs:

```
fm:ce1.c479.09580
dab:ce1.c185.c479.0
http://vis.media-ice.musicradio.com/Capital
```

To the XSI URL:

```
http://epg.musicradio.com/radiodns/epg/XSI.xml
```

Should result in a final URL of:

```
http://epg.musicradio.com/radiodns/epg/XSI.xml?bearer=fm%3Ace1.c479.09580&b
earer=dab%3Ace1.c185.c479.0&bearer=http%3A%2F%2Fvis.media-
ice.musicradio.com%2FCapital
```

### 3.4.2 Service Provider Response

The service provider may use the requested bearer(s) and return a more appropriate response, as determined by the service provider.

The exact implementation is beyond the scope of this document, but a response may include services using the requested bearers, services related to the requested bearers, or indeed no services at all.

### 3.4.3 Client Ingestion

A client **MUST NOT** assume that the original request will be precisely fulfilled by the service provider. Any matching of services should still be done by searching for services using the relevant bearer(s), as would happen when ingesting a more complete XSI (see Section 5.4, Bearer Matching).

Should the client deem the response as not having satisfied the original request, i.e. the requested bearers not matching any services, it may request the URL again without any querystring parameters, i.e. to retrieve the more complete XSI document.

# 4 PI document

This document contains programme and schedule information for a service and is an extension of the PI file in the DAB EPG XML specification [4].

New elements are added in the RadioEPG namespace to provide additional functionality, and the filename conventions and methods of discovery differ to that of the core DAB EPG XML specification.

It is important to note that because the DAB EPG XML PI XSD declaration does not explicitly accommodate elements foreign to its own namespace, a strict validation of this augmented PI file against the PI XSD will fail, and should thus not be attempted.

## 4.1 Location

The document is acquired using a URL constructed using the format:

```
http://<host>:<port>/radiodns/epg/<broadcast parameters>/<date>_PI.xml
```

Where `host` and `port` are populated by the host and port values obtained from the SRV record lookup for the RadioEPG application.

PI documents are stored as a file per day's schedule contained within. The `date` value represents the day you wish to obtain the schedule for. It is populated in the format `YYYYMMDD`, for example Sunday, 9th June, 2013 would be represented as `20130609`.

Note that the service may be located in a different timezone than the device requesting the PI file and, as such, the current date may not be the same for both. Because of this, a device should examine the returned PI file and determine whether the programmes contained within cover the desired time period. If not, additional requests for dates either before or after should be performed, depending on the requirements. The device may use an indication of the service location (e.g. by using the service `location` element, if defined, or by derivation from any indicated broadcast parameters) to better predict the difference in timezones and speed up this process.

The `broadcast parameters` are based on the bearer of the service being consumed and specified in the following subsections, specific to each bearer.

### 4.1.1 7.1.1 VHF/FM

The broadcast parameters value for a VHF/FM service PI request URI is constructed as follows:

```
fm/(<gcc>|<country>)/<pi>/<frequency>
```

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| gcc | **Global Country Code** <br> The Country Code (first nibble of the broadcast RDS PI code) concatenated with the broadcast RDS [7] ECC. | *3-char hexadecimal* | *mutually exclusive* |
| country | **ISO 3166 two-letter country code** <br> In the event that a service broadcast ECC is unavailable, an ISO 3166-1 alpha-2 2-letter country code [6] must be | *2-char string* | |

| | provided. | | |
|---|---|---|---|
| `pi` | **Programme Identification (PI)**<br>Service broadcast RDS PI code. | *4-char hexadecimal* | *mandatory* |
| `frequency` | **Frequency**<br>Frequency on which the service broadcast is received, formatted to 5 characters in units of 100KHz.  Frequencies below 100Mhz must be supplied with a leading zero, for example 95.8MHz would be represented as 09580, 104.9MHz as 10490. | *5-char string* | *mandatory* |

A service provider is **RECOMMENDED** to accept URL requests formatted for both `gcc` and `country` values to handle a situation where the device may not acquire the RDS ECC.

For a detailed explanation on these parameters and their values, please refer to the VHF/FM section of RDNS01 [2].

## 4.1.2   7.1.2   DAB/DAB+ Digital Radio

The broadcast parameters value for a DAB/DAB+ Digital Radio service PI request URI is constructed as follows:

```
dab/<gcc>/<eid>/<sid>/<scids>/[(<appty-uatype>|<pa>)]
```

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `gcc` | **Global Country Code**<br>For services with a 16-bit Service Identifier (SId), this is the first nibble of the SId followed by the Extended Country Code (ECC).<br>For services with a 32-bit SId, this is the third nibble of the SId followed by the first two nibbles of the SId. | *3-char hexadecimal* | *mandatory* |
| `eid` | **Ensemble Identifier (EId)**<br>Service broadcast multiplex ensemble ID code. | *4-char hexadecimal* | *mandatory* |
| `sid` | **Service Identifier (SId)**<br>Service broadcast identifier. | *4 or 8-char hexadecimal* | *mandatory* |
| `scids` | **Service Component Identifier within the Service (SCIdS)**<br>Service broadcast component identifier within the service. | *1 or 3-char hexadecimal* | *mandatory* |

If the audio service is delivered as data via X-PAD, the following additional parameter is mandatory:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `appty-uatype` | **X-PAD Application Type (AppTy) and User Application type (UAtype)**<br>The X-PAD Application Type number and User Application Type, concatenated with a hyphen (only for applications broadcast in X-PAD).  Where Application Types are allocated in pairs, the lower value (indicating the start of the application data group) must be used. | *2-char hexadecimal, hyphen, 3-char hexadecimal* | *mandatory, when referring to an X-PAD component, otherwise omitted* |

If the service is delivered as data in an independent Service Component, the following additional parameter is mandatory:

| Parameters | Description | Value | Status |
|---|---|---|---|
| pa | **Packet Address**<br>Packet address of the data service delivering the audio service. | *integer, between 1 and 1023* | *mandatory, when referring to a data service component, otherwise omitted* |

For a detailed explanation on these parameters and their values, please refer to the DAB/DAB+ section of RDNS01 [2].

### 4.1.3 Digital Radio Mondiale (DRM)/AM Signalling System (AMSS)

The broadcast parameters value for a DRM/AMSS service PI request URI is constructed as follows:

`(drm|amss)/<sid>`

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| sid | **Service Identifier (SId)**<br>Service broadcast identifier. | *6-char hexadecimal* | mandatory |

For a detailed explanation on these parameters and their values, please refer to the DRM/AMSS section of RDNS01 [2].

### 4.1.4 iBiquity Digital Corporation's HD Radio™ (HD Radio™)

The broadcast parameters value for a HD Radio™ [7] service PI request URI is constructed as follows:

`hd/<cc>/<tx>`

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| cc | **Country Code**<br>Service broadcast country code | *3-char hexadecimal* | *mandatory* |
| tx | **Transmitter Identifier**<br>Service broadcast identifier | *5-char hexadecimal* | *mandatory* |

For a detailed explanation on these parameters and their values, please refer to the HD Radio™ section of RDNS01 [2].

### 4.1.5 IP-delivered audio service

The broadcast parameters value for a request URI when receiving IP-delivered audio is constructed as follows:

```
id/<fqdn>/<sid>
```

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `fqdn` | **Authoritative FQDN**<br>This **MUST** match the `fqdn` parameter signalled for the IP stream as per the RadioDNS Specification [2], and the `fqdn` attribute on the `radiodns` element of the service in the relevant XSI document (see Section 3.3.4, radiodns). | *Valid domain name* | *mandatory* |
| `sid` | **Service Identifier**<br>This **MUST** match the `ServiceIdentifer` parameter signalled for the IP stream as per the RadioDNS Specification [2], and the `serviceIdentifier` attribute on the `radiodns` element of the service in the relevant XSI document. | *Maximum 16 lower case characters in the range [a-z][0-9]* | *mandatory* |

## 4.2 Contents

All standard elements within the DAB EPG XML specification PI file can be used. The RadioEPG specification adds to this with extra elements in the RadioEPG namespace, as well as amending some existing elements, as detailed in the following sections.

### 4.2.1 bearer

This additional element exists under the core DAB EPG XML `location` element of each programme, and details the non-DAB bearers that this programme is available on, in the same way that the core DAB EPG XML `bearer` element does for DAB bearers.

Its attributes are formatted in the same way as for the `serviceID` element in the XSI, as detailed in Section 3.3.5, serviceID.

Defining any `bearer` elements within the `location` element of a `programme` element will override a global declaration of bearers in the XSI for the service the programme is carried on, over the duration of the programme. This applies across both common DAB EPG XML bearers and RadioEPG bearers.

Declaring no bearers at this point will mean that any bearers for the programme will inherit from the global declaration of bearers in the XSI for the service the programme is carried on.

### 4.2.2 programme

This existing element is amended in order to make the `id` attribute mandatory. This means that both the `id` and `shortId` attributes **MUST** be defined on a programme.

# 5   Broadcast/IP Service Following

Intelligent switching between broadcast and streaming can be used to provide the device with a common experience between different bearers of the same service, appropriate to the situation. It can also optimise the costs to both device and service provider, associated with the different bearers, e.g. by using broadcast instead of IP streaming.

Service following can be defined globally in the XSI document, or on a per-programme basis in the relevant PI document if available.

## 5.1   Initial Bearer Selection

For a situation where a device is not already receiving a service, it is up to the device how it select an initial bearer. It is **RECOMMENDED** that this be a function of device preference, user preference and indicated bearer cost.

A device should determine the relative preference between certain bearers based on its own functionality (e.g. what bearers the device is able to use, available codecs).

A device may wish to expose a degree of choice of bearer to the user and allow them to indicate a preference to a particular bearer. This may also be an indirect consequence of a user action – for example, if a user deactivates Wi-Fi functionality on a mobile/cellular network phone, the device may decide to use FM instead of IP streaming over mobile data.

A *cost* is indicated against each bearer for a service, as determined by the service provider and indicates an order of preference *in respect to the service provider*. This is a relative non-negative non-zero integer, which may be used to select the *most preferred* bearer from the bearer list. The bearer with the lower cost value should be preferred when performing a comparison.

A device should start from the most preferred bearer and work down the list until it is deemed a successful reception has been made. A device should apply its own rules to determine what constitutes a successful reception, such as whether the broadcast signal quality is sufficiently strong, or whether an IP connection can be made and the available bandwidth is sufficient.

## 5.2   Bearer Switching Behaviour

Service following information provided in the XSI document enables a device to consider a transition to IP streaming of the current service when all possible service following possibilities in the broadcast domain for the current service have been exhausted. It also allows a device receiving a service through IP streaming to consider switching to the same service on a broadcast bearer.

In all cases, the provided bearer cost should be considered in the decision to switch between broadcast and IP, and when deciding which of either broadcast or IP to switch to if multiple equitable options are available.

Information provided in the XSI is not intended to be used in preference to information provided by a broadcast platform, such as AF information in RDS-FM and Service Following information in DAB. Where the broadcast platform allows signalling of similar services, such as Soft Links in DAB, the device may decide whether to offer the user a switch to the same service on IP streaming, or one of the alternative similar services specified in the broadcast domain.

For example, consider a service being received on DAB. DAB Service Following provides alternative locations for the current service on other ensembles and on FM radio, but the device finds that none are of an acceptable signal quality.

The device inspects the RadioEPG Service Following information, finds an appropriate IP streaming bearer for the current service, and switches to that. The device continues to monitor the broadcast signals available to it, and finds at a later time that the same service is now available with equitable signal qualities on both DAB and FM.

The service provider has specified a lower cost for the DAB bearer, so the device switches from IP Streaming to DAB. Devices should implement appropriate strategies for managing the frequency and duration of switches between IP and broadcast.

The value for an *offset* of a particular bearer, in milliseconds relative to other bearers in the same document, may allow the device to implement functionality to attempt co-timing when switching bearers, or to assist a decision as to the most appropriate bearer. It should be noted that any offset is an indicative, rather than precise value.

## 5.3  Implementation

The following matrix gives the conditions under which Service Following to another bearer may or may not be implemented by a device:

| XSI Available | PI Available | | Device Behaviour |
|---|---|---|---|
| **Bearers defined for this service** | | **Bearers defined in current programme** | |
| N | N | - | Service following **not** allowed |
| Y | N | - | Service following allowed to bearers defined for this service, within the XSI |
| Y | Y | N | Service following allowed to bearers defined for this service, within the XSI |
| Y | Y | Y | Service following allowed to bearers defined for the current programme, within the `location` element of the PI |
| N | Y | Y | Service following allowed to bearers defined for the current programme, within the `location` element of the PI |
| N | Y | N | Service following **not** allowed |

*Available* and *Unavailable* refer to whether a document (XSI or PI) can or cannot be retrieved using HTTP as per Section 2, Document retrieval.

*Bearer present* refers to a bearer being within the document, either within the `service` element of the XSI file, or the `location` element of the current programme within the PI file. This signals that the bearer is allowed for that service/programme.

*Bearer missing* refers to a bearer not being within the document, either within the `service` element of the XSI file, or the `location` element of the current programme within the PI file. This signals that the bearer is not allowed for that service/programme.

A Service Provider may wish to signal different bearer availability on a per-programme for a variety of reasons, e.g. to enforce licensing restrictions.

## 5.4 Bearer Matching

A device may ingest an XSI document for a variety of reasons. For example, in order to determine which service is currently being received and its associated metadata, or to find other bearers the service can be received on.

The implementation of this should be through *Bearer Matching*, i.e. constructing the URI of the currently received bearer using the methods described in Section 7, Bearer URI Construction. This URI can then be matched against bearers within the XSI document to find the relevant service(s). Note that more than one service may be matched, at which point a device may take additional steps to match the current service, for example by using location information.

As well as matching bearers by available broadcast parameter, it is **RECOMMENDED** that a device also match against any available additional bearer parameters (e.g. bitrate, MIME type).

# 6   Preference of RadioEPG over existing EPG delivery methodologies

It is acknowledged that DAB and DRM have existing methods in place for the delivery of EPG data over the broadcast platform. This specification is not designed to replace these.  However, it may only be possible for some service providers to offer EPG data over IP through a system such as RadioEPG.  The aim of this specification is to provide a common method for multiple audio delivery protocols for radio.

On certain services it is possible that EPG data may be available both as part of a broadcast and also via RadioEPG over IP. In this case, it is up to device implementation which data is used.

It is **RECOMMENDED** that service providers ensure any broadcast EPG data is similarly available over IP using RadioEPG.

# 7 Bearer URI Construction

A bearer may be expressed in a URI format [15], with the format specific to the bearer platform. The following sections detail the schemes as defined within this version of the RadioEPG specification.

## 7.1 VHF/FM

The bearer string for a VHF/FM service is constructed as follows:

```
fm:(<gcc>|<country>).<pi>.<freq>
```

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| gcc | **Global Country Code**<br>The Country Code (first nibble of the broadcast RDS PI code) concatenated with the broadcast RDS [7] ECC. | *3-char hexadecimal* | *mutually exclusive* |
| country | **ISO 3166 two-letter country code**<br>In the event that a service broadcast ECC is unavailable, an ISO 3166-1 alpha-2 2-letter country code [6] must be provided. | *2-char string* | |
| pi | **Programme Identification (PI)**<br>Service broadcast RDS PI code. | *4-char hexadecimal* | *mandatory* |
| frequency | **Frequency**<br>Frequency on which the service broadcast is received, formatted to 5 characters in units of 100KHz. Frequencies below 100MHz must be supplied with a leading zero, for example 95.8MHz would be represented as 09580, 104.9MHz as 10490. | *5-char string* | *mandatory* |

For a detailed explanation on these parameters and their values, please refer to the VHF/FM section of RDNS01 [2].

## 7.2 DAB/DAB+ Digital Radio

The bearer string for a DAB/DAB+ Digital Radio service is constructed as follows:

```
dab:<gcc>.<eid>.<sid>.<scids>[.(<appty-uatype>|<pa>)]
```

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| gcc | **Global Country Code**<br>For services with a 16-bit Service Identifier (SId), this is the first nibble of the SId followed by the Extended Country Code (ECC).<br>For services with a 32-bit SId, this is the third nibble of the SId followed by the first two nibbles of the SId. | *3-char hexadecimal* | *mandatory* |

| Parameters | Description | Value | Status |
|---|---|---|---|
| `eid` | **Ensemble Identifier (EId)**<br>Service broadcast multiplex ensemble ID code. | *4-char hexadecimal* | *mandatory* |
| `sid` | **Service Identifier (SId)**<br>Service broadcast identifier. | *4 or 8-char hexadecimal* | *mandatory* |
| `scids` | **Service Component Identifier within the Service (SCIdS)**<br>Service broadcast component identifier within the service. | *1 or 3-char hexadecimal* | *mandatory* |

If an audio service is delivered as data via X-PAD, the following additional parameter is mandatory:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `appty-uatype` | **X-PAD Application Type (AppTy) and User Application type (UAtype)**<br>The X-PAD Application Type number and User Application Type, concatenated with a hyphen (only for applications broadcast in X-PAD).  Where Application Types are allocated in pairs, the lower value (indicating the start of the application data group) must be used. | *2-char hexadecimal, hyphen, 3-char hexadecimal* | *mandatory, when referring to an X-PAD component, otherwise omitted* |

If an audio service is delivered as data in an independent Service Component, the following additional parameter is mandatory:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `pa` | **Packet Address**<br>Packet address of the data service delivering the audio service. | *integer, between 1 and 1023* | *mandatory, when referring to a data service component, otherwise omitted* |

For a detailed explanation on these parameters and their values, please refer to the DAB/DAB+ section of RDNS01 [2].

## 7.3  Digital Radio Mondiale (DRM)/AM Signalling System (AMSS)

The bearer string for a DRM/AMSS service is constructed as follows:

`(drm|amss):<sid>`

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| `sid` | **Service Identifier (SId)**<br>Service broadcast identifier. | *6-char hexadecimal* | mandatory |

For a detailed explanation on these parameters and their values, please refer to the DRM/AMSS section of RDNS01 [2].

## 7.4 iBiquity Digital Corporation's HD Radio™ (HD Radio™)

The bearer string for a HD Radio™ [7] service is constructed as follows:

```
hd:<cc>.<tx>.<frequency>
```

The parameters are populated with the following values:

| Parameters | Description | Value | Status |
|---|---|---|---|
| cc | **Country Code**<br>Service broadcast country code | *3-char hexadecimal* | *mandatory* |
| tx | **Transmitter Identifier**<br>Service broadcast identifier | *5-char hexadecimal* | *mandatory* |
| frequency | **Frequency**<br>Frequency on which the service broadcast is received, formatted to 5 characters in units of 100KHz.  Frequencies below 100MHz must be supplied with a leading zero, for example 95.9MHz would be represented as 09590, 104.9MHz as 10490. | *5-char string* | |

For a detailed explanation on these parameters and their values, please refer to the HD Radio™ section of RDNS01 [2].

## 7.5 HTTP-based

The bearer string takes the form of a valid URL as defined in the HTTP specification [3]. For example:

```
http://media-ice.musicradio.com/Capital
```

## 7.6 Other Bearers

While other bearers exist over which audio can be carried (e.g. DVB, IPTV, etc.) this version of the RadioEPG specification does not define the format by which they may be expressed.

# 8 Example RadioEPG Documents

## 8.1 Example XSI Document

```xml
<?xml version="1.0" encoding="UTF-8"?>
<serviceInformation xmlns="http://schemas.radiodns.org/epg/11"
xmlns:epg="http://www.worlddab.org/schemas/epgDataTypes/14"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://schemas.radiodns.org/epg/11
http://schemas.radiodns.org/epg/11/radioepg_xsi_11.xsd"
   creationTime="2013-05-23T14:05:00+01:00" originator="Global Radio" xml:lang="en">
   <services>
      <serviceProvider>
         <epg:shortName xml:lang="en">Global</epg:shortName>
         <epg:mediumName xml:lang="en">Global Radio</epg:mediumName>
         <mediaDescription>
            <epg:multimedia url="http://epg.musicradio.com/logos/global/320x240.png"
mimeValue="image/png" type="logo_unrestricted" height="240" width="320" />
         </mediaDescription>
         <mediaDescription>
            <epg:multimedia url="http://epg.musicradio.com/logos/global/32x32.png"
mimeValue="image/png" type="logo_colour_square" height="32" width="32" />
         </mediaDescription>
         <keywords xml:lang="en">radio, television, publishing, talent, charities &amp;
            communities
         </keywords>
         <link url="http://www.thisisglobal.com" mimeValue="text/html" description="Global homepage"
xml:lang="en" />
         <link url="postal:Global%20Radio/30%20Leicester%20Square/London/WC2H%207LA" />
         <link url="tel:+44-020-77666000" />
         <location>
            <country>GB</country>
            <point>51.473939 -2.508112</point>
         </location>
      </serviceProvider>
      <service>
         <serviceID id="dab:ce1.c185.c479.0" mime="audio/mpeg" offset="2000" cost="20" />
         <serviceID id="fm:ce1.c479.09580" cost="30" />
         <serviceID id="http://media-ice.musicradio.com/Capital" offset="4000" mime="audio/aacp"
bitrate="48" cost="40" />
         <serviceID id="http://media-ice.musicradio.com/CapitalMP3Low" offset="4000" mime="audio/mpeg"
bitrate="48"
            cost="40" />
         <epg:shortName xml:lang="en">Capital</epg:shortName>
         <epg:mediumName xml:lang="en">Capital FM</epg:mediumName>
         <epg:longName xml:lang="en">Capital London</epg:longName>
         <epg:shortDescription xml:lang="en">London's No.1 Hit Music Station</epg:shortDescription>
         <mediaDescription>
            <epg:shortDescription xml:lang="en">London's No.1 Hit Music Station</epg:shortDescription>
         </mediaDescription>
         <mediaDescription>
            <epg:multimedia type="logo_colour_square"
url="http://owdo.thisisglobal.com/2.0/id/25/logo/32x32.png" />
         </mediaDescription>
         <mediaDescription>
            <epg:multimedia type="logo_colour_rectangle"
url="http://owdo.thisisglobal.com/2.0/id/25/logo/32x96.png" />
         </mediaDescription>
         <mediaDescription>
            <epg:multimedia height="128" type="logo_unrestricted"
url="http://owdo.thisisglobal.com/2.0/id/25/logo/128x128.png"
               width="128" />
         </mediaDescription>
         <mediaDescription>
            <epg:multimedia height="240" type="logo_unrestricted"
url="http://owdo.thisisglobal.com/2.0/id/25/logo/320x240.jpg"
               width="320" />
         </mediaDescription>
         <mediaDescription>
            <epg:multimedia height="480" type="logo_unrestricted"
```

```xml
url="http://owdo.thisisglobal.com/2.0/id/25/logo/640x480.jpg"
                width="640" />
        </mediaDescription>
        <mediaDescription>
            <epg:multimedia height="800" type="logo_unrestricted"
url="http://owdo.thisisglobal.com/2.0/id/25/logo/800x800.jpg"
                width="800" />
        </mediaDescription>
        <epg:genre href="urn:tva:metadata:cs:ContentCS:2004:3.6.10">
            <epg:name>Hit-Chart/Song Requests</epg:name>
        </epg:genre>
        <epg:genre href="urn:tva:metadata:cs:ContentCS:2004:3.6.8">
            <epg:name>Electronic/Club/Urban/Dance</epg:name>
        </epg:genre>
        <epg:genre href="urn:tva:metadata:cs:ContentCS:2004:3.1.1.11">
            <epg:name>Local/Regional</epg:name>
        </epg:genre>
        <epg:genre href="urn:tva:metadata:cs:ContentCS:2004:3.6.8.14">
            <epg:name>Dance/Dance-pop</epg:name>
        </epg:genre>
        <epg:genre href="urn:tva:metadata:cs:ContentCS:2004:3.1.4.12">
            <epg:name>Showbiz</epg:name>
        </epg:genre>
        <keywords xml:lang="en">London, music, pop, rock, dance, urban</keywords>
        <link description="Text the Studio" url="sms:83958" />
        <link url="http://www.capitalfm.com/london" mimeValue="text/html" xml:lang="en" />
        <location>
            <country>GB</country>
            <polygon>
                51.524124 -2.709503 51.572803 -2.668304 51.616310 -2.572174
                51.575363 -2.412872 51.504471 -2.379913 51.426613 -2.471924
                51.400063 -2.460937 51.387211 -2.511749 51.328896 -2.708130
                51.273087 -2.772675 51.238705 -2.938843 51.258476 -3.036346
                51.376068 -3.026733 51.472401 -2.859879 51.524124 -2.709503
            </polygon>
        </location>
        <radiodns fqdn="www.capitalfm.com" serviceIdentifier="london" />
        <memberOf id="capital" />
    </service>
    </services>
    <groups>
        <group id="capital">
            <epg:shortName>Capital</epg:shortName>
            <epg:mediumName>Capital FM</epg:mediumName>
            <mediaDescription>
                <epg:shortDescription xml:lang="en-GB">
                    The UK's No.1 Hit Music Station
                </epg:shortDescription>
            </mediaDescription>
            <link description="Capital FM on Wikipedia" mimeValue="text/html"
url="http://en.wikipedia.org/wiki/Capital_(radio_network)" />
            <mediaDescription>
                <epg:multimedia type="logo_colour_square"
url="http://owdo.thisisglobal.com/2.0/id/153/logo/32x32.png" />
            </mediaDescription>
            <mediaDescription>
                <epg:multimedia type="logo_colour_rectangle"
url="http://owdo.thisisglobal.com/2.0/id/153/logo/32x112.png" />
            </mediaDescription>
            <mediaDescription>
                <epg:multimedia height="128" type="logo_unrestricted"
url="http://owdo.thisisglobal.com/2.0/id/153/logo/128x128.jpg"
                    width="128" />
            </mediaDescription>
            <mediaDescription>
                <epg:multimedia height="240" type="logo_unrestricted"
url="http://owdo.thisisglobal.com/2.0/id/153/logo/320x240.jpg"
                    width="320" />
            </mediaDescription>
            <mediaDescription>
                <epg:multimedia height="480" type="logo_unrestricted"
url="http://owdo.thisisglobal.com/2.0/id/153/logo/640x480.jpg"
                    width="640" />
```

```xml
          </mediaDescription>
        </group>
    </groups>
</serviceInformation>
```

## 8.2 Example PI Document

```xml
<?xml version="1.0" encoding="UTF-8"?>
<epg xmlns="http://www.worlddab.org/schemas/epgSchedule/14"
     xmlns:epg="http://www.worlddab.org/schemas/epgDataTypes/14"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xmlns:repg="http://schemas.radiodns.org/epg/11"
     xsi:schemaLocation="http://www.worlddab.org/schemas/epgSchedule/14
http://www.worlddab.org/schemas/epgSchedule/14/epgSchedule_14.xsd"
xml:lang="en">
  <schedule version="1" creationTime="2009-10-05T00:00:00+01:00" originator="Global Radio">
    <scope startTime="2009-10-05T06:00:00+01:00" stopTime="2009-10-05T13:00:00+01:00"/>
    <programme shortId="1190223" id="crid://www.capitalfm.com/1190223" recommendation="yes">
      <epg:shortName>B'fast</epg:shortName>
      <epg:mediumName>Breakfast</epg:mediumName>
      <epg:longName>Capital Breakfast</epg:longName>
      <epg:location>
        <epg:time time="2009-10-05T06:00:00+01:00" duration="PT4H0M0S"
                  actualTime="2009-10-05T06:00:00+01:00" actualDuration="PT4H0M0S"/>
        <epg:bearer id="ce1.c185.c586.0"/>
        <repg:bearer id="dab:ce1.c185.c586.0" mime="audio/mpeg" bitrate="128" cost="10"/>
        <repg:bearer id="fm:ce1.c586.09580" cost="30"/>
        <repg:bearer id="http://media-ice.musicradio.com/Capital" offset="4000" mime="audio/aacp"
                     bitrate="56" cost="40"/>
        <repg:bearer id="http://vis.media-ice.musicradio.com/CapitalMP3Low" mime="audio/mpeg"
                     bitrate="56" cost="40"/>
      </epg:location>
      <epg:mediaDescription>
        <epg:shortDescription>Forget the coffee, Capital gives you the perfect morning pick-me-up with
a blend of the latest hits, travel news and incomparable morning banter.</epg:shortDescription>
      </epg:mediaDescription>
      <epg:genre href="urn:tva:metadata:cs:ContentCS:2002:3.6.8">
        <epg:name><![CDATA[ Electronic/Club/Urban/Dance]]></epg:name>
      </epg:genre>
      <epg:genre href="urn:tva:metadata:cs:IntentionCS:2002:1.1">
        <epg:name><![CDATA[ ENTERTAINMENT]]></epg:name>
      </epg:genre>
      <epg:memberOf shortId="1000" id="crid://www.capitalfm.com/london/breakfast"/>
      <epg:link url="mailto:capital.breakfast@capitalfm.com" description="Email the Capital Breakfast
team!" />
      <epg:link url="http://www.capitalfm.com/on-air/breakfast-show/" />
      <epg:programmeEvent shortId="11902231" id="crid://thisisglobal.com/1190223/1"
                          recommendation="yes">
      <epg:shortName xml:lang="en">Pun</epg:shortName>
      <epg:mediumName xml:lang="en">No.1 Pun</epg:mediumName>
      <epg:longName xml:lang="en">London's No. 1 Pun</epg:longName>
      <epg:location>
        <epg:relativeTime time="PT3H10M" duration="PT25M"/>
      </epg:location>
      <epg:mediaDescription>
        <epg:shortDescription xml:lang="en">
          Can you come up with London's No.1 Pun for our story of the day?
        </epg:shortDescription>
      </epg:mediaDescription>
      </epg:programmeEvent>
    </programme>
  </schedule>
</epg>
```

# 9  Schema Definitions

Due to the limitations of using an XSD to define an extensible schema, the following sections are primarily useful for documenting structure, rather than providing a means of validation.

## 9.1  XSI XSD

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns="http://schemas.radiodns.org/epg/11"
           targetNamespace="http://schemas.radiodns.org/epg/11"
           xmlns:xs="http://www.w3.org/2001/XMLSchema"
           xmlns:epg="http://www.worlddab.org/schemas/epgDataTypes/14"
           xmlns:georss="http://www.georss.org/georss"
           elementFormDefault="qualified"
           attributeFormDefault="unqualified">

  <xs:import namespace="http://www.w3.org/XML/1998/namespace"
             schemaLocation="http://www.w3.org/2001/xml.xsd" />
  <xs:import namespace="http://www.worlddab.org/schemas/epgDataTypes/14"

schemaLocation="http://www.worlddab.org/schemas/epgDataTypes/14/epgDataTypes_14.xsd" />
  <xs:import namespace="http://www.georss.org/georss"
             schemaLocation="http://georss.org/xml/1.1/georss.xsd" />


  <xs:element name="serviceInformation">
  <xs:complexType>
   <xs:sequence>
    <xs:element name="services" type="servicesType" minOccurs="0" maxOccurs="1" />
    <xs:element name="groups" type="groupsType" minOccurs="0" maxOccurs="1" />
   </xs:sequence>
   <xs:attribute name="creationTime" type="epg:timePointType" />
   <xs:attribute name="originator" type="epg:originatorType" />
   <xs:attribute name="serviceProvider" type="epg:serviceProviderType" />
   <xs:attribute ref="xml:lang" use="required" />
  </xs:complexType>
 </xs:element>

 <xs:complexType name="groupsType">
  <xs:sequence>
   <xs:element name="group" type="groupType" maxOccurs="unbounded" />
  </xs:sequence>
 </xs:complexType>

 <xs:complexType name="servicesType">
  <xs:sequence>
   <xs:element name="serviceProvider" type="serviceProviderType" minOccurs="0"
maxOccurs="1" />
   <xs:element name="service" type="serviceType" minOccurs="0" maxOccurs="unbounded" />
  </xs:sequence>
 </xs:complexType>

<xs:complexType name="serviceProviderType">
  <xs:sequence>
   <xs:group ref="epg:serviceNameGroup" maxOccurs="unbounded" />
   <xs:element name="mediaDescription" type="epg:mediaDescriptionType"
               minOccurs="0" maxOccurs="unbounded" />
   <xs:element name="link" type="epg:linkType" minOccurs="0" maxOccurs="unbounded" />
   <xs:element name="location" type="locationType" minOccurs="0" maxOccurs="1" />

  </xs:sequence>
```

```
      </xs:complexType>

    <xs:complexType name="serviceType">
     <xs:sequence>
      <xs:element name="serviceID" type="serviceIDType" minOccurs="0" maxOccurs="unbounded" />
      <xs:group ref="epg:serviceNameGroup" maxOccurs="unbounded" />
      <xs:element name="mediaDescription" type="epg:mediaDescriptionType"
                   minOccurs="0" maxOccurs="unbounded" />
      <xs:element name="genre" type="epg:genreType" minOccurs="0" maxOccurs="unbounded" />
      <xs:element name="keywords" type="epg:keywordsType" minOccurs="0"
                   maxOccurs="unbounded" />
      <xs:element name="link" type="epg:linkType" minOccurs="0" maxOccurs="unbounded" />
      <xs:element name="memberOf" type="memberOfType" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="radiodns" type="radiodnsType" minOccurs="0" maxOccurs="1" />
      <xs:element name="location" type="locationType" minOccurs="0" maxOccurs="1" />
     </xs:sequence>
    </xs:complexType>

    <xs:complexType name="memberOfType">
     <xs:attribute name="id" type="xs:string" use="required" />
    </xs:complexType>

    <xs:complexType name="radiodnsType">
     <xs:attribute name="fqdn" type="xs:string" use="required" />
     <xs:attribute name="serviceIdentifier" type="xs:string" use="required" />
    </xs:complexType>

    <xs:complexType name="serviceIDType">
     <xs:attribute name="id" type="xs:anyURI" />
     <xs:attribute name="mime" type="xs:string" />
     <xs:attribute name="bitrate" type="xs:nonNegativeInteger" />
     <xs:attribute name="cost" type="xs:nonNegativeInteger" />
     <xs:attribute name="offset" type="xs:nonNegativeInteger" default="0"/>
    </xs:complexType>

    <xs:complexType name="locationType">
     <xs:sequence>
        <xs:element name="point" type="georss:point" minOccurs="0" maxOccurs="unbounded" />
        <xs:element name="polygon" type="georss:polygon" minOccurs="0" maxOccurs="unbounded" />
        <xs:element name="country" type="xs:string" minOccurs="0" maxOccurs="unbounded" />
     </xs:sequence>
    </xs:complexType>

    <xs:complexType name="groupType">
     <xs:sequence>
      <xs:group ref="epg:serviceNameGroup" maxOccurs="unbounded" />
         <xs:element name="mediaDescription" type="epg:mediaDescriptionType"
                      minOccurs="0" maxOccurs="unbounded" />
         <xs:element name="genre" type="epg:genreType"
                      minOccurs="0" maxOccurs="unbounded" />
         <xs:element name="keywords" type="epg:keywordsType"
                      minOccurs="0" maxOccurs="unbounded" />
         <xs:element name="link" type="epg:linkType" minOccurs="0" maxOccurs="unbounded" />
     </xs:sequence>
     <xs:attribute name="id" type="xs:string" />
    </xs:complexType>

</xs:schema>
```

## 9.2 PI XSD Extensions

As the PI XML file has been augmented with the RadioEPG-specific `bearer` element, and the original DAB EPG XML XSD file does not explicitly allow foreign elements, it may no longer be deemed valid by a validating parser.

However, for reference purposes, the following element is defined:

```xml
<xs:element name="bearer" type="serviceIDType"/>
```

## 9.3 Amendments to the DAB EPG XML datatypes

The DAB EPG XML XSD defines the core datatype for a `link` element in such a way as to restrict the link to be a URL limited to a certain set of schemes.

In this specification, this restriction is relaxed such that **any** valid URI [15] may be specified in the `url` attribute of this element.

# 10 Guidance for usage of Linked Content

The `link` element may be used within XSI and PI files in order to indicate additional *linked* content from the parent element. This will link out to external resources, which devices or clients may optionally make use of.

The use of an external resource depends on factors such as whether it is capable of making use of the resource, and possible user choice or preferences. The resource may be shown/indicated to a user or it may be ingested as part of a client process.

No particular behaviour is mandated, and the following sections serve to provide guidance as to ways in which a device or client may use this information including, but not limited to:

- Service/Group/Programme website links

- Podcasts/On-Demand content

- External identities for the Service/Group/Programme

The attributes of the link should be used in the following manner:

| Parameters | Description |
|---|---|
| `url` | **Link URI**<br>The URI may be deconstructed and examined to infer context, particularly by using the URI Scheme (HTTP, FTP, etc.) to determine a particular protocol. Depending on the protocol, the rest of the URI may then be examined for additional context. For example, an HTTP URI contains a host that may be used to infer the context of the link. |
| `mimeValue` | **MIME Type**<br>May used to gather more context on the format of the resource, and potentially what it represents. |
| `xml:lang` | **Language**<br>Indicates the language of the linked resource. This is most useful when the same link is being provided in different languages (i.e. for multilingual services/programmes/groups), to be used to select the most appropriate from a group of similar links. |

The following sections give guidance for specific examples for using the `link` element:

## 10.1 Website Links

This indicates related HTTP content, usable by a web browser. Several abridged examples are shown below.

**Programme Links**

Showing a link to programme information on the station website, and a microsite for a specific feature within the show:

```
<programme shortId="1190223" id="crid://thisisglobal.com/1190223">
    ...
    <epg:link url="http://www.capitalfm.com/on-air/breakfast-show" />
    <epg:link url="http://www.capitalfm.com/timetunnel" description="Can you guess the
year?" />
    ...
  <programme/>
```

In the above example, no MIME Type is specified on either link. However, context can still be inferred from the URI scheme (HTTP), such that a device may reasonably expect the content to be displayable in a Web Browser.

**Service Links**

Showing the station homepage, and entry on Wikipedia:

```
<service>
  ...
  <link url"http://www.capitalfm.com/london" mimeValue="text/html"/>
  <link url="http://en.wikipedia.org/wiki/Capital_London" mimeValue="text/html"
xml:lang="en"/>
  ...
</service>
```

The links should be ordered in such a way that the most significant link appears first, for the purposes of disambiguating between otherwise equally significant links.

For example, a Broadcaster may order the list in such a way that the first link with an HTTP scheme to their own domain refers to their Company, Service, Brand or Programme website.

## 10.2  Podcasts/On-Demand Content

Podcast and on-demand information could be specified as a link from a Service, Programme or Group.

A device may interpret linked content as a podcast from its MIME type. For example, extending the example given in 10.1, a Programme linking to an RSS and an Atom feed:

```
<programme shortId="1190223" id="crid://thisisglobal.com/1190223">
  ...
  <epg:link url="http://www.capitalfm.com/on-air/breakfast-show/podcast"
mimeValue="application/rss+xml"  />
  <epg:link url="http://www.capitalfm.com/on-air/breakfast-show/podcast"
mimeValue="application/atom+xml" />
  ...
<programme/>
```

Podcasts and On-Demand content may be included in any number of formats, not limited to RSS and Atom, available over a range of protocols/methods. A device may select appropriate feeds to use based on a number of factors, such as the indicated MIME Type (if given), structure of the URI, or the result of acquiring the feed and examining it.

## 10.3  External Identities

A Service, Programme or Group could have identities external to the Broadcaster, e.g. within a directory service or aggregator.

Providing the link between this identity and the Broadcaster's own service definition enables the metadata in both these places to be associated, or to use the combined information in a specific way such as within an application on a mobile device.

The identity should be formatted in a way that is specific to the provider of that identity, typically as a URL. For example, a service aggregator may hold information for a particular Service at the URL indicated in the XSI:

```
<link url="http://www.musicradio.com/directory/service-16859"
```

```
                    mimeValue="text/html" />
```

Since this is the URL as supplied by the aggregator, it will be formatted in a way known to that aggregator – in this case, including a numeric identifier.

When the aggregator ingests the Broadcaster's XSI file, it will be able to link from its own representation of the service to the Broadcaster's by identifying the service with this link. In this way, the URL is acting as a 'Foreign Key' between the two sources of information for that service.

A service may have multiple of these external identifiers, thereby allowing a network of identities between different providers to be linked together.

A URL such as the one shown in the above example may also be used as a normal HTTP URL to be displayed in a web browser on the device, in this case showing the aggregator's page on the service.

If the aggregator does not have the means to provide a URL containing the identity of the service, a URI may be specified, for example:

```
        <link url="musicradio:16859" />
```

As in the first example, the URI may be used as a key between the Broadcaster and the Aggregator. However, the device would need to know how to interpret this URI syntax, perhaps by launching an application capable of handling the URI.

## 10.4  Contact Details

A Service, Programme or Group could have associated contact details, such as a Postal Address [4], telephone number [12] or SMS short code [13, combined with the protocol defined in 14].  For example:

```
        <link url="postal:Global%20Radio/30%20Leicester%20Square/London/WC2H%207LA" />
        <link url="tel:+44-020-77666000" />
        <link url="sms:83958" />
```

# 11 Guidance for usage of Images

## 11.1 Content Negotiation

When a device wishes to acquire a logo image for a service, it is **RECOMMENDED** that the following headers be specified within the HTTP request:

| Name | Value | Status |
|---|---|---|
| Display-Width | Device display width in pixels | *Optional* |
| Display-Height | Device display height in pixels | *Optional* |
| Display-PPI | Device display pixel density in Pixels Per Inch (PPI) | *Optional (default 72)* |

It is **RECOMMENDED** that the device also send the standard HTTP request header **User-Agent**. This should describe the general device profile, as in the HTTP specification, but must not contain any user identifiable information.

These header values **MAY** be used by the server providing the resource, as additional information to select the most appropriate resource.

The resultant image returned may exactly match the requested dimensions, or may be close to these values, dependent on the ability of the broadcaster to supply exact image sizes. The broadcaster may decide to ignore the indicated device screen dimensions entirely, and return a logo of the dimensions given in the XSI for this URL, as these values are deemed to be the *default* dimensions.

The device must therefore examine the dimensions of a returned logo as they may not exactly match the device screen dimensions. Padding and scaling in order to best fit the device may be performed, although the original aspect ratio of the image must be preserved.

# 12 History

| Document history | | |
|---|---|---|
| V0.6.1 | June, 2009 | First Working Draft |
| V1.0.0 | April, 2012 | Publication |
| V1.1.0 | October, 2013 | Numerous updates, corrections and clarifications.<br>Moved `serviceProvider` from attribute to its own element.<br>Added mandatory logo sizes for services.<br>Added location information to services, programmes and groups.<br>Guidance on linked content and external identities.<br>Guidance for use of logos. |