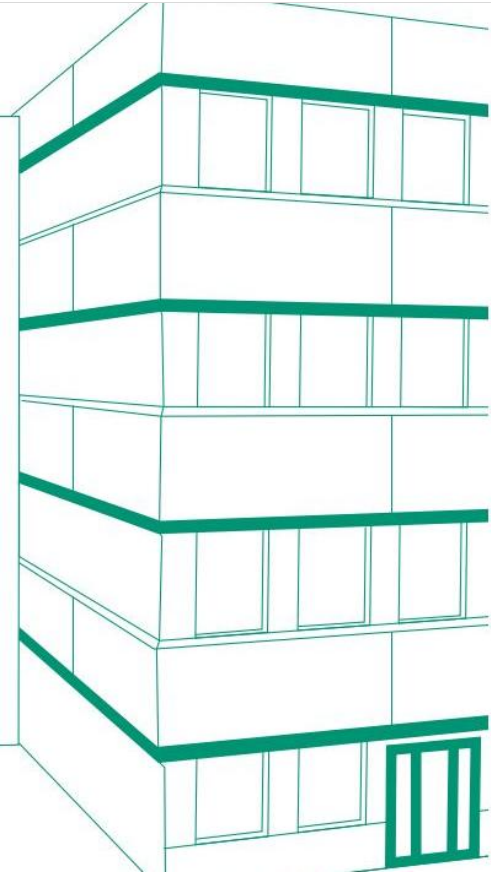
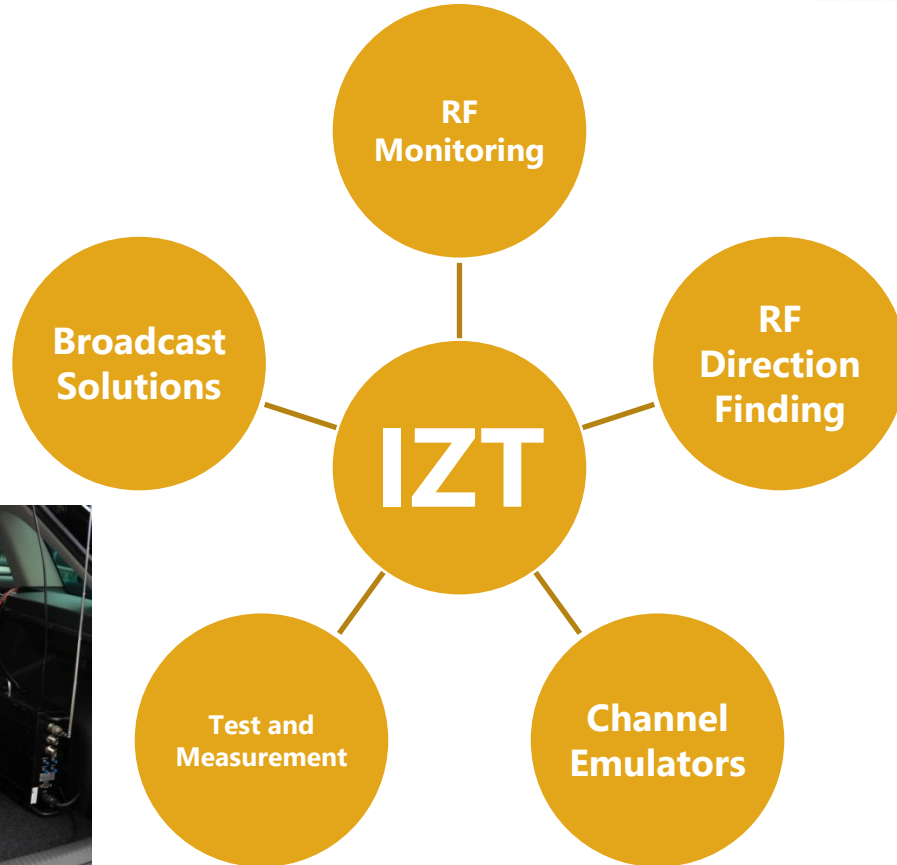
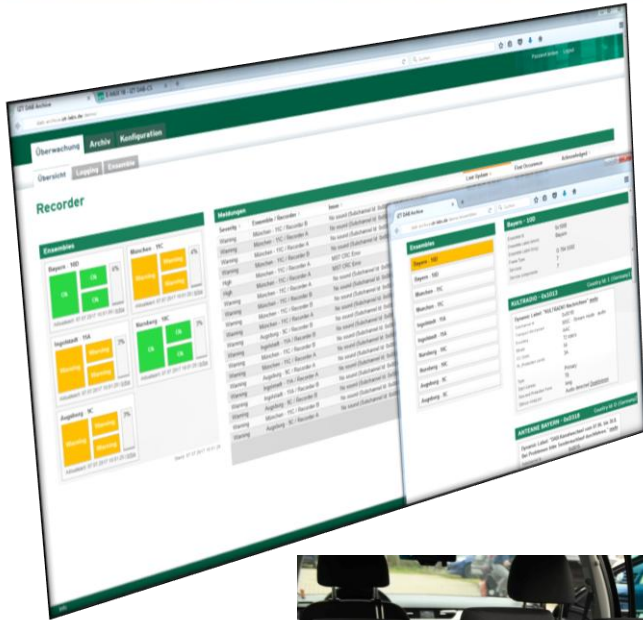




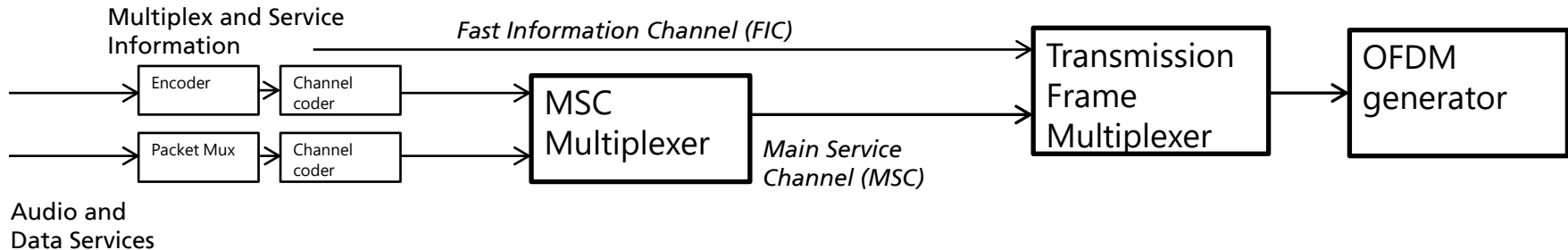
DAB Encoding and multiplexing systems

Arne Borsum





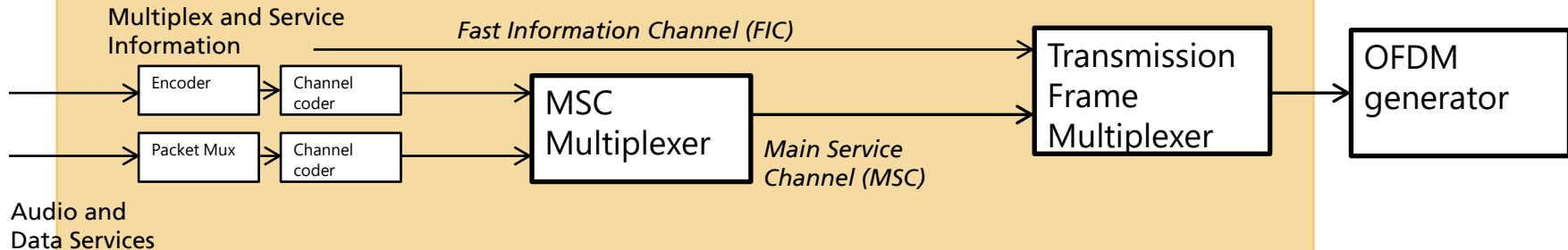
Generation of a DAB Signal



On the basis of *Digital Audio Broadcasting*, Hoeg et. al., page 48

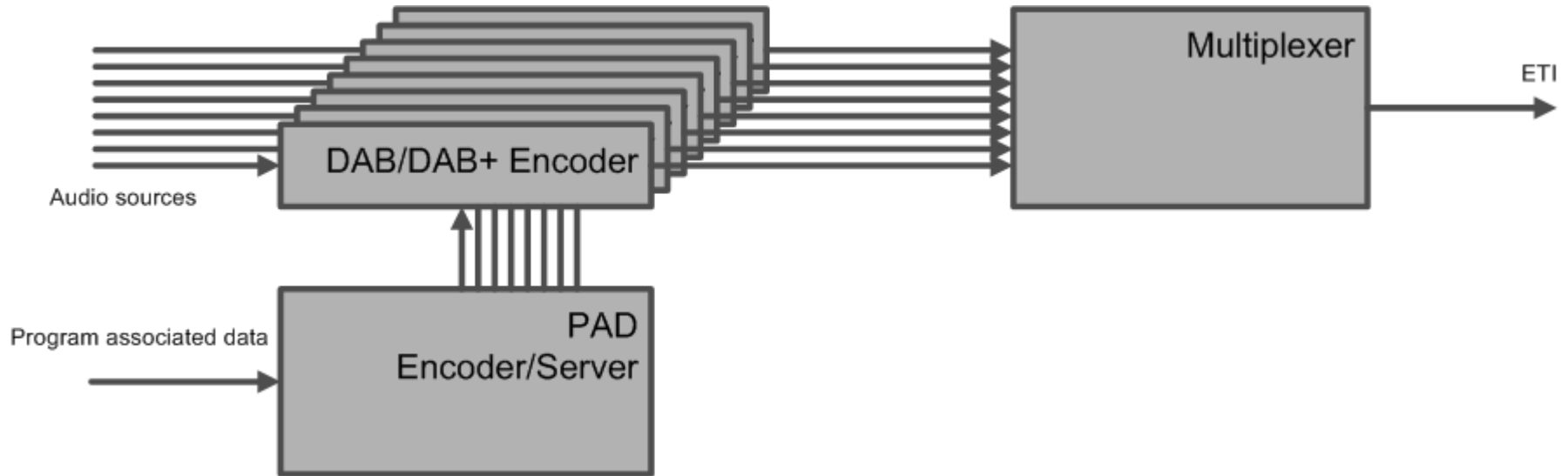
Generation of a DAB Signal

DAB Head end

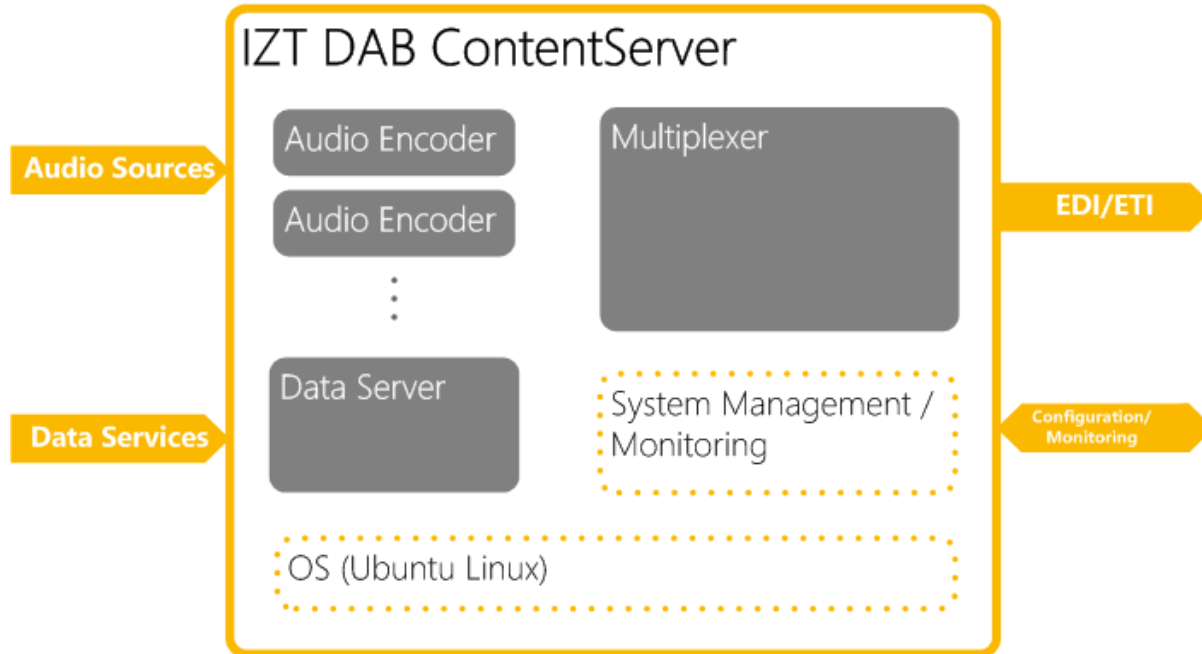


On the basis of *Digital Audio Broadcasting*, Hoeg et. al., page 48

Dedicated Hardware (legacy)

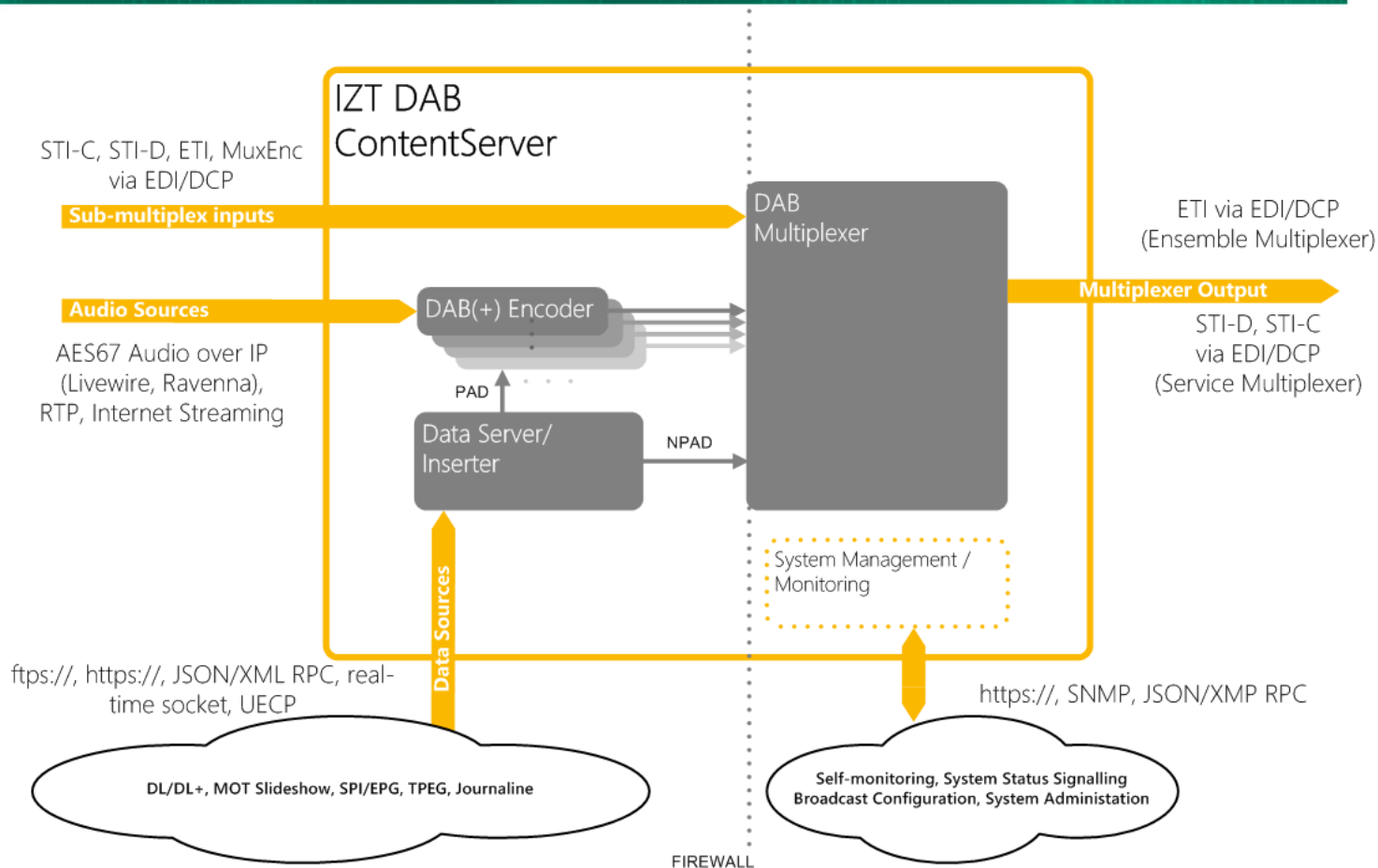


Integrated Software System



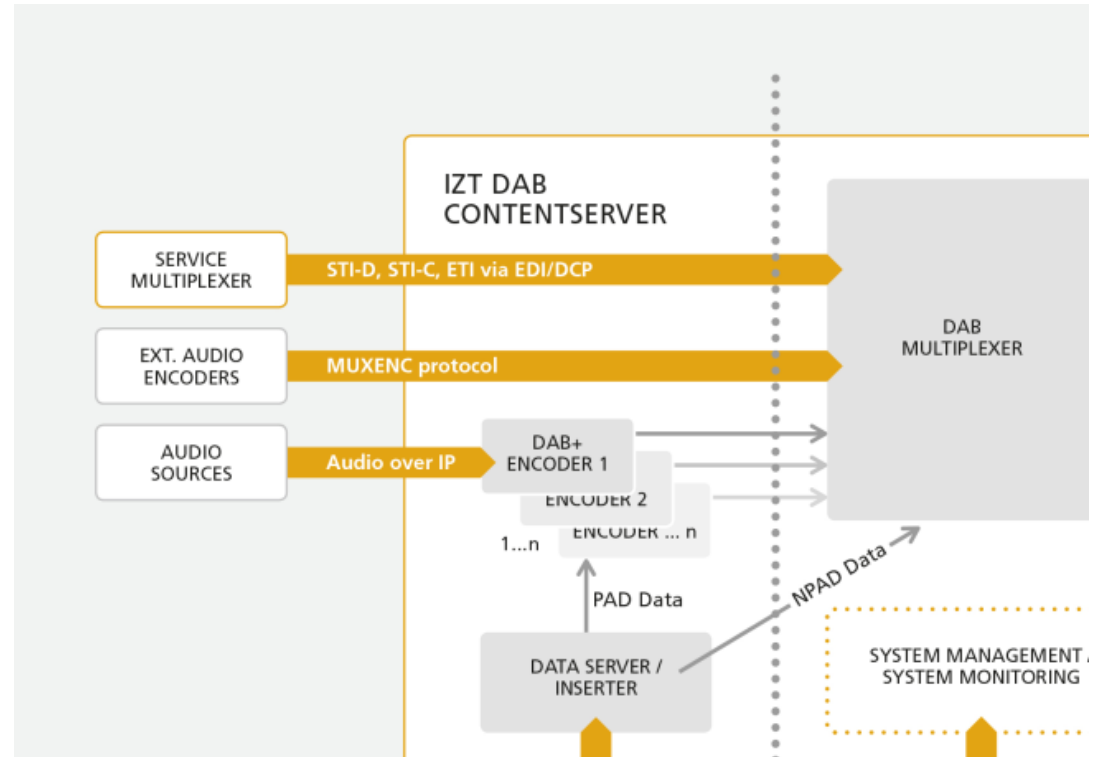
- Real-time DAB, DAB+ Audio encoding
- Data service and multimedia management
- Multiplex generation
- Flexible and extendible interfacing
- Remote configuration and monitoring

Head-end Components and Interfaces



Options for DAB/DAB+ Audio Encoding

- Internal audio encoders of the multiplexer system
- Remote audio encoders via STI-D/EDI, MuxEnc



Audio contribution options

Support of different protocols allows for flexible integration into infrastructures

- AES67 Audio over IP (Livewire, Ravenna – uncompressed PCM audio via RTP streaming)
- External converters from Analog/Digital audio to AES67 available
- Compressed RTP Streaming sources (MPEG-4 AAC, HE-AAC, HE-AACv2, AAC-LD, AAD-ELD, MPEG Layer 2, MPEG Layer 3)
- Signalling: EBU-ACIP, SDP, RTSP, SIP
- Internet Streaming (Shoutcast/Icecast)

Variety of protocols allows integration into existing or new workflows

Examples

- **DL/DL+:** UECP, JSON-RPC, XML-RPC, RSS, Realtime TCP/IP Interface, Web Interface, FTP upload, HTTP/FTP Mirroring
- **MOT Slideshow:** JSON-RPC, XML-RPC, Realtime TCP/IP Interface, FTP upload, HTTP/FTP Mirroring
- **TPEG:** Realtime TCP/IP Interface, Realtime UDP/IP Interface, FTP upload, HTTP/FTP Mirroring

Content can directly be provided from studio automation, existing RDS infrastructure, vis GUI or file-based.

JSON/RPC Examples

Send DL+

```
{
  "jsonrpc": "2.0",
  "method": "Provision.sendLabel",
  "params": {
    "login": "rpc_labels_1",
    "password": "Czu1lKky",
    "label": "Currently playing: <item.artist>Eagles</item.artist>/<item.title>Hotel California</item.title>"
  },
  "id": 1
}
```

Send Slide

```
{
  "jsonrpc": "2.0",
  "method": "Provision.sendSlide",
  "params": {
    "login": "rpc_slides_1",
    "password": ".UN5oaXY",
    "motparameters": {
      "ContentName": "101_caching.png",
      "TriggerTime": "2019-03-24T09:49"
    },
    "data": "..."
  },
  "id": 1
}
```

File-based and Web Interface import

Input of Text Messages

Please type all your dynamic labels / text messages one per line. A line ends when you press the "Enter" key (↵).
The use of DL Plus tags is **not** possible (it could be permitted in the Service Component settings).

```
العربية \LRIGerman!\PDI
العربية German!\LRM
```

Integrated Software System

- Linux environment
- Scalable functionality
- Convenient web interface for configuration and monitoring

Hardware

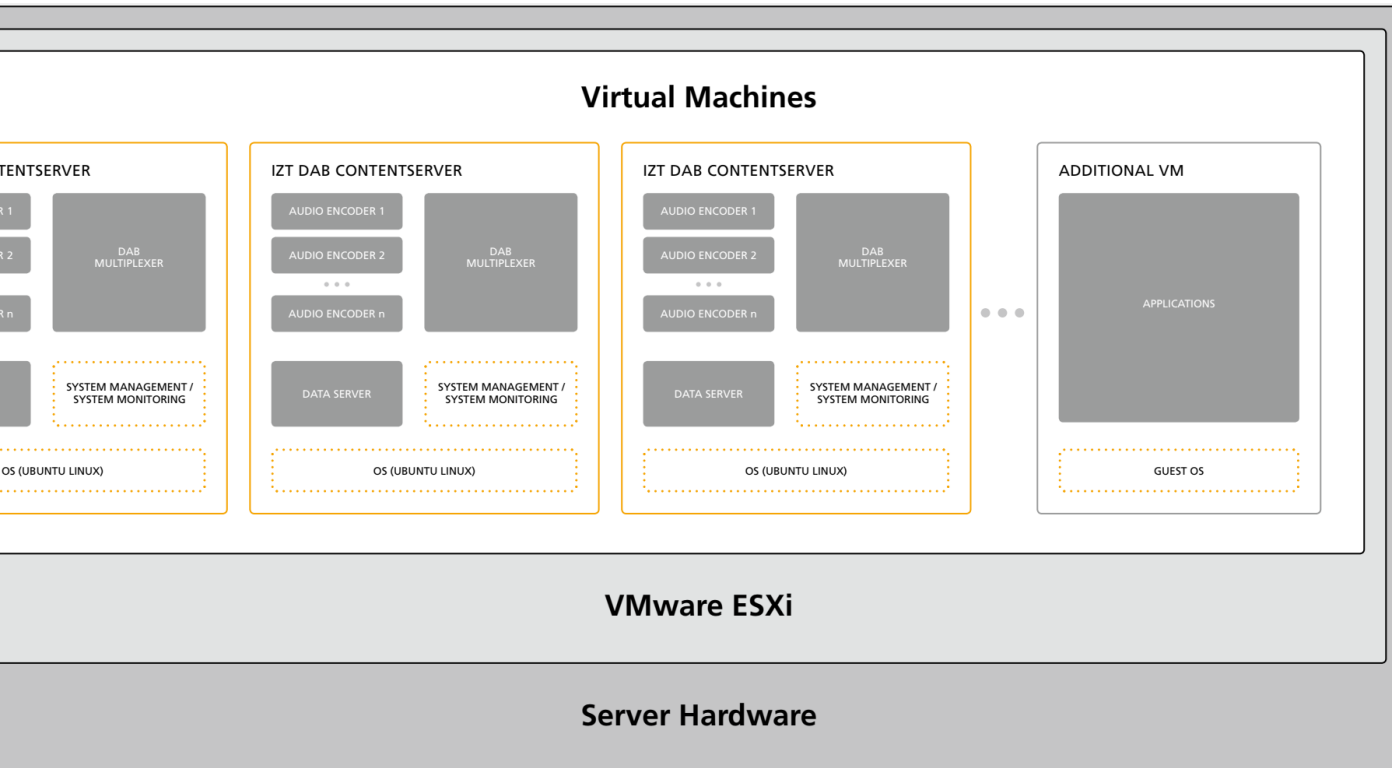
- Highly reliable standard server hardware
- RAID1 + hot spare, dual power supply
- Continuous short-term availability of spare parts
- Easy migration of software system to new hardware

Turn-key

- Quick and easy deployment



Virtualization



- One VM per ContentServer instance incl. Multiplexer and Encoders
- Flexible network management and routing with vmWare virtual switch functionality

Virtualization

- Operation of DAB head-ends in IT data centers
- Shared infrastructure with other applications



Virtualization PRO

- Cost savings (rack space)
- Consistent, standardized infrastructure and connectivity to transport content
- Maintenance takes advantage of harmonized hardware
- Flexible restructuring of processes/applications and flexible reaction to hardware failures

Virtualization CON

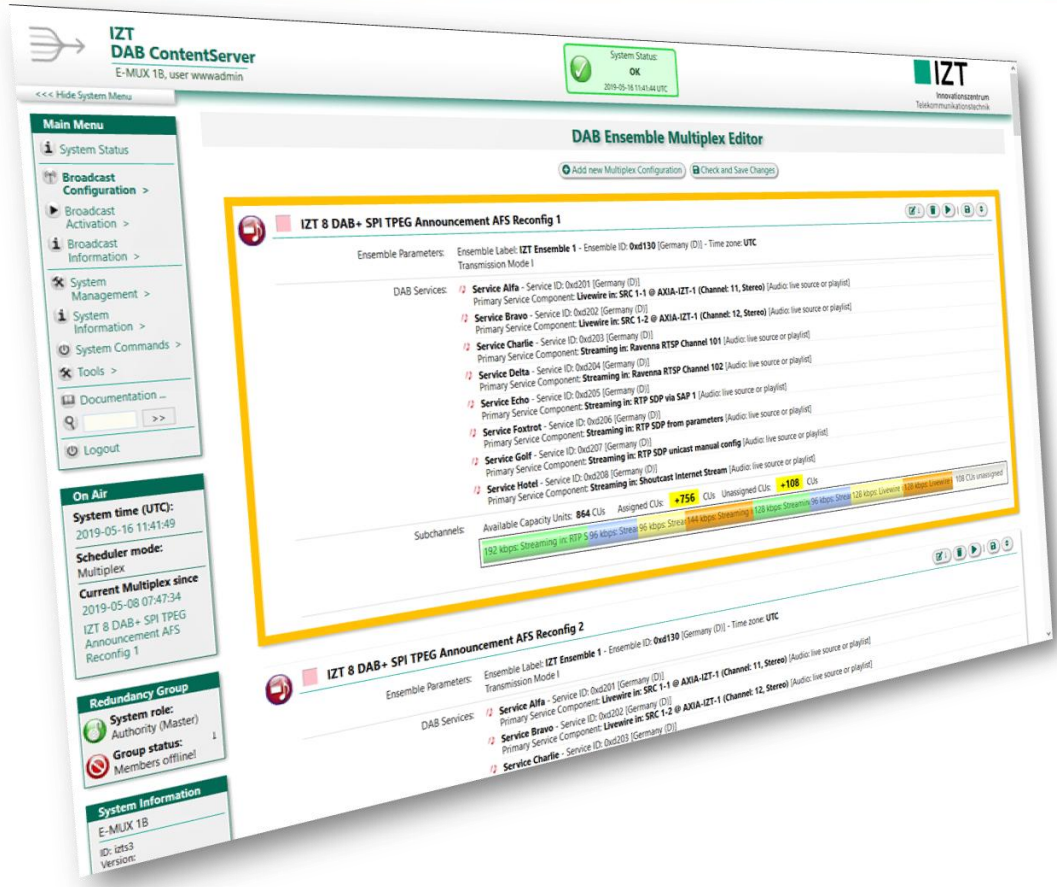
- Limited savings in sharing capacities
- Limited cost savings in general (mainly rack space)
- More complex in terms of synchronization and timing
- Cost for reliable data transfer from/to data center
- Overall reliability may depend on hosting infrastructure, connectivity and other applications

Configuration and Monitoring



Innovationszentrum
Telekommunikationstechnik

Web GUI for convenient configuration



Web GUI for convenient configuration

The screenshot displays the 'IZT 8 DAB+ SPI TPEG Announcement AFS Reconfig 2' web interface. It features a navigation bar with tabs for 'Multiplex Parameters', 'DAB Services', 'Subchannels', and 'Special Signalling'. The main content area is divided into several sections:

- Multiple Subchannel Configuration Overview:** Shows 'Available Capacity Units: 864 CUs', 'Assigned CUs: +546 CUs', and 'Unassigned CUs: +318 CUs'. A progress bar indicates '318 CUs unassigned'.
- DAB Audio Subchannel - Livewire in: SRC 1-1 @ AXIA-IZT-1 (Channel: 11, Stereo) - Used by: Service Alfa:** Displays 'Net Bitrate in Stream: 44000 bps' and 'Unassigned bitrate: none'. A progress bar shows '41466 bps: Livewire in: SRC 1-1 @ AXIA-IZT-1 (Channel: 11, Stereo)'.
- General DAB Subchannel Parameters:** Includes dropdowns for 'Subchannel Bitrate: 48 kbps', 'Protection level: EEP 3-A (38 CUs)', and 'Available Net Bitrate: 44000 bps'.
- DAB Audio Parameters - Livewire in: SRC 1-1 @ AXIA-IZT-1 (Channel: 11, Stereo) (Audio: live source or playlist):** Features radio buttons for 'Audio Codec: DAB+ (HE-AAC v2) / MPEG Audio Layer 2', 'Audio Bitrate (net): 41466 bps (gross PAD bitrate: 2534 bps)', 'DAC Sampling Rate: 48 kHz / 32 kHz', 'Audio Mode: stereo / parametric stereo / mono', 'SBR: disabled / enabled', and 'MPEG Surround Mode: No MPEG Surround'. A note states: 'No MPEG Surround (If you want to encode a stereo signal at a sample rate of 48000 Hz with SBR, you need a bitrate between 58666 bps (net) and 124666 bps (net); you have 41466 bps)'. An 'Auto-optimize audio parameters' button is also present.
- Service Component Parameters - slideshow1 (Application: Slideshow):** Shows 'Bitrate (bps): 1000'.
- Service Component Parameters - labels1 (Application: Dynamic labels):** Shows 'Bitrate (bps): 1000'.
- DAB Audio Subchannel - Livewire in: SRC 1-2 @ AXIA-IZT-1 (Channel: 12, Stereo) - Used by: Service Bravo:** Shows 'Subchannel Bitrate: 48000 bps'.
- DAB Audio Subchannel - Streaming in: Ravenna RTSP Channel 101 - Used by: Service Charlie:** Shows 'Subchannel Bitrate: 64000 bps'.

Versatile APIs

Multiplex Activation

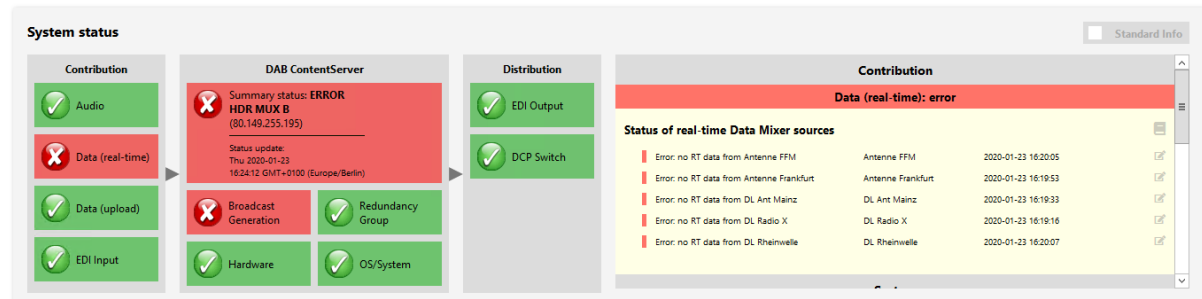
- Web Interface/URL call, JSON/XML-RPC, SNMP

Dynamic Signalling

- Announcement Signalling – UECP, Web Interface/URL call, JSON/XML-RPC, SDI/DCP, GPIO Node
- Other Ensemble (OE) Announcement Signalling – UECP, Web Interface/URL call, JSON/XML-RPC, SDI/DCP, GPIO Node
- Programme Type (PTy) – UECP, JSON/XML-RPC, SDI/DCP
- Linkage Sets – JSON/XML-RPC, SDI/DCP, Programm signal_Isn

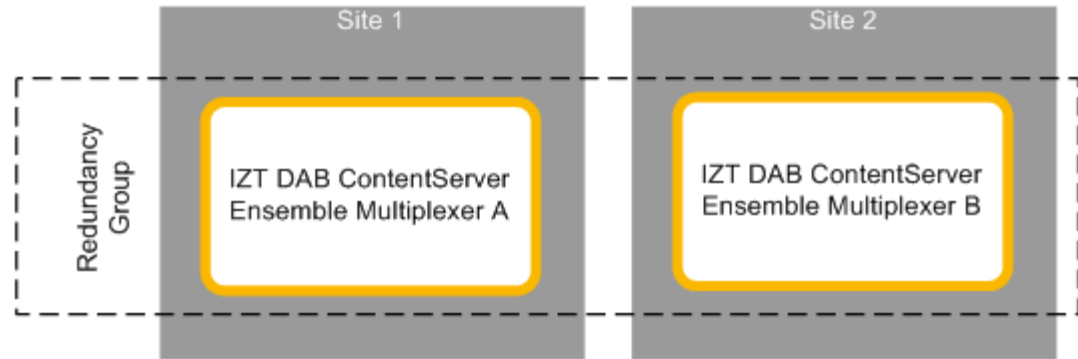
System Monitoring

- Graphical System Status
- E-Mail Notification
- SNMP

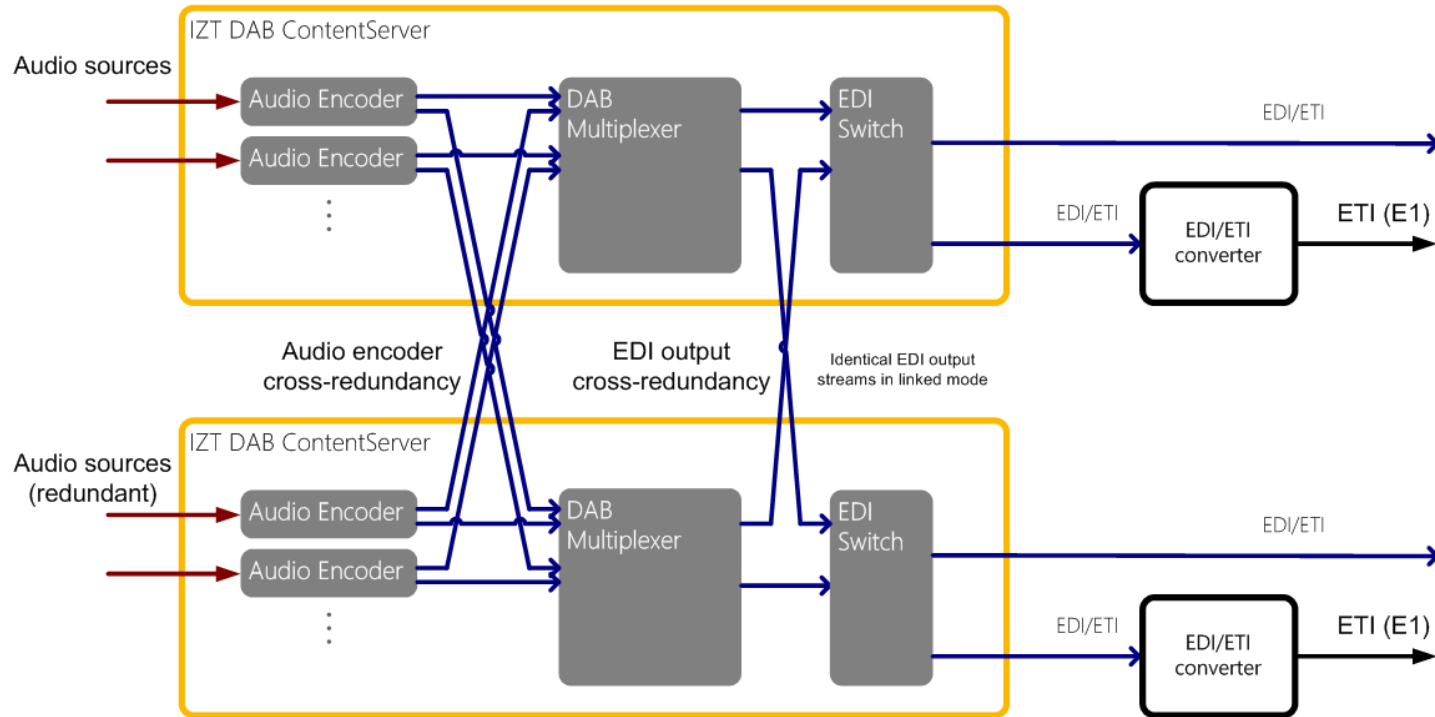


1+1 Redundancy Group

- Automatic "Master"/"Slave" Assignment
- Identical configurations, schedules and content
- 1+1 EDI output streams for redundant network feed



Audio and EDI Output Redundancy



Modern DAB multiplexer systems provide flexible and scalable functionality of a complete DAB head-end.

Implementation options allow smooth integration into existing and new infrastructures.