The future role of broadcast in a world of wireless broadband
ITG Workshop Sound, Vision & Games

Ulrich Reimers, Jan Zöllner, 22 September 2015
Structure of my presentation

1. (Terrestrial) Broadcast and wireless broadband today – some observations
2. Our approaches to „bridging solutions“
3. Redundancy on Demand (RoD)
4. Dynamic Broadcast
5. Tower Overlay over LTE-A+ (TOoL+)
6. Conclusion
This is the world of terrestrial (TV) broadcast today – it is **colourful**

(Source: www.dvb.org)
In 2019 mobile video will be responsible for 72% of all mobile data traffic?

Mobile Network Operators (MNOs) are **spectrum hungry** and will try to push terrestrial broadcast out of the UHF band?

<table>
<thead>
<tr>
<th>Unternehmen</th>
<th>Frequenzmenge</th>
<th>Zuschlagspreis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telefónica Deutschland GmbH &amp; Co. OHG</td>
<td>700 MHz: 2 x 10 MHz, 900 MHz: 2 x 10 MHz, 1800 MHz: 2 x 10 MHz</td>
<td>1.198.238.000 €</td>
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<tr>
<td>Telekom Deutschland GmbH</td>
<td>700 MHz: 2 x 10 MHz, 900 MHz: 2 x 15 MHz, 1800 MHz: 2 x 15 MHz, 1500 MHz: 20 MHz</td>
<td>1.792.156.000 €</td>
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<td>Vodafone GmbH</td>
<td>700 MHz: 2 x 10 MHz, 900 MHz: 2 x 10 MHz, 1800 MHz: 2 x 25 MHz, 1500 MHz: 20 MHz</td>
<td>2.090.842.000 €</td>
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<td><strong>Gesamt</strong></td>
<td><strong>270 MHz</strong></td>
<td><strong>5.081.236.000 €</strong></td>
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In Germany, a spectrum auction has taken place already. It included the 700 MHz band. All three MNOs have acquired parts of the UHF band (2*10 MHz each).

In consequence, German broadcasters plan to migrate from DVB-T to DVB-T2 between 2017 and 2019.
The crystal ball: **Video coding in 2016**

- Using HEVC, in 2016 the following data rates should be realistic (aggressively defined, but the numbers are supported by colleagues at Fraunhofer HHI)

- For HDTV receivers of the „living room“ type 5 Mbit/s video plus 0.8 Mbit/s for audio etc. are required
  - → 222 min. TV viewing per day leads to: 9.6 GByte/day, **290 GByte/month**

- For Tablet PCs with a „retina display“, 1 Mbit/s video plus 0.4 Mbit/s for audio etc. are required
  - It is unclear how long people will watch video on tablets in the future
  - → 1 hour requires 630 Mbyte
  - → 1 hour per day every day requires **18.9 GByte/month**

- With a view to the fact that true flat rate tariffs are a dying species: What will be cost implications for the user if (wireless) broadband will have to deliver these amounts of data?

  Another question arises: Will people really watch „Live“ video on portable devices? If classical terrestrial broadcast should no longer be available, the answer is: „Yes“
If „Live“ video on Tablet PCs and other portable devices is required, then:

- One or more of the following network technologies will have to do the job:
  - WiFi – for all of us, this is an extremely important delivery network technology based on a fixed Internet connection. WiFi experiences congestion in many built-up areas
  - Long Term Evolution (LTE) in unicast mode
  - LTE with eMBMS (evolved Multimedia Broadcast Multicast Service)
  - A „bridging solution“ combining the best of the (terrestrial) broadcast and the wireless broadband worlds

- Is the following scenario completely unrealistic?
  - Olympic Games 2020 in Tokyo
  - In Germany, eight parallel „Live“ video streams @ 1.4 Mbit/s each are requested by viewers in 2/3 of the 30,000 network cells of each of the 3 mobile network operators
IfN in Braunschweig…

- … continues to do research on traditional broadcast systems such as DVB-T2 (specializing on the reception in high speed environments such as cars and trains) and ATSC 3.0
- But our main focus is on „bridging solutions“ – bridging the gap between wireless broadband and broadcast systems
- Our first proposal is „Dynamic Broadcast“
- Our second proposal is the „Tower Overlay over LTE-A+ (TOoL+)“
- Our third proposal is „Redundancy on Demand (RoD)“

Why „bridging solutions“? We are aware of:

- The rather dramatic increase of video consumption in mobile data networks
- The increasing pressure on terrestrial broadcast spectrum (really?)
- The growing popularity of mobile devices such as Tablet PCs
- The loss of importance of classical terrestrial broadcast (at least in Germany)
We are able to realise our systems via **Software Defined Radio** and meanwhile we are able to achieve „live quality“

Example: An in-car receiver for **DVB-T2**
Approach No. 1: **Dynamic Broadcast**

- Dynamic Broadcast assumes that classical terrestrial broadcast is maintained and that the viewers continue to enjoy the traditional viewing comfort.
- Dynamic Broadcast retains the dominant role of broadcasters in defining their program schedules.
- Despite accepting these two boundary conditions, Dynamic Broadcast makes spectrum available for wireless broadband.
- The fundamental concept behind Dynamic Broadcast is the time-multiplexed allocation of spectrum.

- One positive effect of Dynamic Broadcast is the fact, that TV White Spaces now are managed actively.
Approach No. 2: Tower Overlay over LTE-A+ (TOoL+)

- TOoL+ enables a joint and co-timed use of spectrum by both classical terrestrial broadcast and wireless broadband networks – without being tied to the existence of classical terrestrial broadcast since that may disappear over time.

- At the same time we assume that mobile devices with high-quality displays (e.g. Tablet PCs) will be able to present „live-HQ-video“. We are convinced that cellular technologies will not be able to offer these services in an economically acceptable way – where „acceptable“ relates to both the cost for network operators and for the end customers.

- And we assume that broadcast tuners will not be implemented in Smartphones and Tablets in a large scale. One reason? The plurality of broadcast standards (Sorry! DVB-H, DVB-SH, DVB-NGH, and MediaFLO told us a lesson).
**Approach No. 3: Redundancy on Demand**

- With this approach we support classical terrestrial broadcast networks in times of ever tighter spectrum resources and of increasing interference.
- The *coverage area* of a classical terrestrial broadcast network is extended (for instance for deep indoor reception). If the signal quality of the terrestrial broadcast signal is insufficient, the receiver *pulls some redundancy information* via (wireless or fixed) broadband network.
- This approach was *jointly developed* by Sony and TUBS.

- By the way: Our systems have been introduced in the DVB-Project.
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Redundancy on Demand (RoD)

- State of the art TV receivers are equipped with both broadcast (terrestrial, cable, satellite) frontends AND broadband network interfaces (Ethernet, WiFi …)
- So far, the media content is either received via the broadcast OR via the broadband interface
- RoD extends the coverage of terrestrial TV broadcast by use of the broadband network
- The RoD receiver requests „redundancy“ via the broadband network if the transinformation on the broadcast network is insufficient. Redundancy may be single FEC packets
- A primary target of RoD is optimizing indoor reception in metropolitan areas
- Convergence of broadcast and broadband happens on the physical layer
The RoD system

- A RoD server generates the required redundancy data
- A RoD receiver requests redundancy if required and decodes the broadcast signal with support by the RoD data
- As shown in the diagram, RoD is backwards compatible
- Yes, **buffering** is required in the RoD receiver in order to compensate for the request cycle (for typically **200 ms**)
- Since DVB-T2 uses Physical Layer Pipes (PLPs) only the redundancy for the PLP actually watched needs to be delivered
The RoD system – already **field tested** in the DVB-T2 network in Berlin in 2015
The graphical user interface of the **RoD receiver** tells the whole story

By the way: in the field trial in Berlin we used **LTE** for delivering RoD data to an in-car RoD receiver.
Now let us create a **more radical** approach: Broadcast and broadband networks cooperate above the physical layer

- Why does all content have to be broadcasted – even if only few people watch it? Let us deliver „the long tail“ over broadband and save cost on the broadcast network

- With a view to the storage capacity available in the receivers, **not all** content needs to be transmitted in „**real time**“ since some of it can be pre-transmitted and (securely) stored for presentation at the on-air time decided by the broadcaster. And: content that will be **repeated** will not have be transmitted again

- This is where **Dynamic Broadcast** comes into the picture

- Dynamic Broadcast frees capacity on the broadcast channels and thus gives broadcasters the chance to distribute **additional virtual channels**

- Dynamic Broadcast enables a dynamic use of TV spectrum and thereby supports the use of **White Space devices** in spectrum managed by the broadcaster

- At least in certain countries broadcast network operators can make „**dual use**“ of the TV spectrum by operating wireless broadband networks inside „their own spectrum“
Popularity distribution of TV events – an example

- The example used here are two DVB-T multiplexes in operation in Germany: Each carries four TV channels (programmes)
Overview of the Dynamic Broadcast system

Important: The viewers will not notice any difference in comparison to traditional TV broadcast.

Broadcast media content ➡️ RF transmission ➡️ Control channel

White Space Device

Dynamic White Space Database

Secondary Wireless Broadband Network

User Terminal

Broadcasting

Decision Logic

Packaging of Media Content (real-time and non-real-time)

Joint Control Transmission Parameters etc.

Multiplexing and Content Distribution

Monitoring and Signalling

Network
Dynamic Broadcast requires/offers **new degrees of freedom**

- In order to make broadcast network structures „dynamic“ some or all of the following degrees of freedom will be exploited – **dynamically over time**:
  - Choice of **live** broadcast or of content **pre-download** or of local **replay** of repeat content
  - Choice of **delivery network** (broadcast or broadband)
  - **Multiplex** configurations of the broadcast network
  - **Channel** allocations in the broadcast network
  - **Transmission** parameters of the broadcast network

- We first demonstrated the system live at IFA Berlin 2012

- (May be, this approach is a bit **too radical**?)
Tower Overlay over LTE-A+ (TOoL+): The concept

- Both LTE and LTE eMBMS are based on a *more or less dense cellular infrastructure* which we believe is too costly for the delivery of popular media content.

- In our system, popular video services are provided on a dedicated carrier via a **Tower Overlay** over the cellular network.

- The overlay becomes part of the LTE-A+ network by means of LTE-A+ **carrier aggregation** to ensure simultaneous provision of unicast, eMBMS, and broadcast services.

- The LTE-A+ Smartphone or Tablet **does not have to be equipped with a broadcast frontend** to receive the signal.
The LTE-A+ signals are embedded in **Future Extension Frames** provided by DVB-T2 (and by ATSC 3.0).
LTE-A+ signals? Look at this spectrum

This is LTE-A+ at 5 MHz. We can also show LTE-A+ at 8 MHz
TOoL+ has already been **field-tested** in Paris in 2015 and is on air in the Aosta Valley in Italy (and in Braunschweig)

- Two independent DVB-T2 and LTE-A+ network components, sharing a broadcast frequency

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This diagram was designed by Pierre Bretillon, TDF
In-car reception of TOoL+ in the Aosta Valley

Our RAI colleagues receiving the LTE-A+ component in a car moving through Aosta
Conclusion

- With the availability of DVB-T2, terrestrial broadcast networks have reached a fabulous efficiency and performance. ATSC 3.0 promises to provide similar quality.

- Despite such excellence, terrestrial broadcast is challenged by a variety of alternative ways to deliver media content and by the ever-growing importance of “media-capable” portable devices such as Smartphones and Tablet PCs.

- More than ever before operators of terrestrial broadcast networks need to define long-term strategies in a fast developing media world in which even their right to use spectrum exclusively may no longer be guaranteed.

- At the same time Mobile Network Operators (MNOs) are facing a video avalanche which may jeopardize their current business models.

- This is why the IfN is determined to offer new approaches for terrestrial media distribution – come and join us.
Thank you for your attention!

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